Gas Journal

DECEMBER 12, 1934

Vol. 208. 86th Year No. 3734.

Editorial Notes

The Mellor Laboratories

CAN refractories research be interesting to the layman as well as to the expert? We think that those who attend the Autumn Research Meetings of the Institution of Gas Engineers would have no doubt as to the answer. There is a perceptible sitting-up of the audience when Mr. A. T. Green, Assistant Director of Research to the B.R.R.A., mounts the platform to present the Report on Refractories Research. They have been led to expect two things—a great deal of information and also a good laugh, for Mr. Green is able to infuse humour even into a graph. We also say right away that Mr. Green's enthusiasm for his work is translated into the research staff at Stoke-on-Trent.

The foregoing is *a propos* an interesting experience we enjoyed last week—a visit to the new headquarters of the British Refractories Research Association. It was the occasion of the official christening of the new Mellor Laboratories, to which the B.R.R.A. have moved from their former quarters at the North Staffordshire Technical College. All present at this private view must have been impressed by the keenness and ability of those who are carrying out research work on refractories at the new laboratories. The value to the Gas Industry of this research during past years is acknowledged, and the whole Industry owes a debt of gratitude to Lieut.-Col. C. T. Thomas, Chairman of the B.R.R.A., and Dr. J. W. Mellor, Director of Research, who were responsible for the commencement of organized research on refractories in this country. On the other hand, the B.R.R.A., who have had such a staunch friend in Mr. Frank West, owe a very great deal to the Institution of Gas Engineers, who early recognized the need for this research and were the first in the field to give practical financial support. It was fitting that those who inspected the Mellor Laboratories last week should include Mr. C. Valon Bennett, President of the Institution of Gas Engineers, and Mr. F. P. Tarratt, immediate Past-President. An outline of the history of the Association is given on later pages of our issue to-day. Suffice it to say here that, in spite of ups and downs, at no time in the existence of the Association have the auspices been so favourable or the prospects so bright as they are at the present time.

Considerable assistance—financial grants—have come from the Department of Scientific and Industrial Research. It is significant, however, that at a luncheon to celebrate the christening of the new Laboratories, Sir Kenneth Lee, a member of the Advisory Council of the Department of Scientific and Industrial Research, said that the Committee had arrived at the conclusion that a sum of £10,000 to £12,000 a year represents the minimum for an independent research association. "It is," he remarked, "a great mistake to carry on research unless it can be undertaken thoroughly." At present the funds of the B.R.R.A. fall short of the £10,000 mark—a state of affairs which, we hope, will not persist.

As for the Laboratories themselves, these are admirable in every way for the prosecution of the research in hand or likely to be contemplated. At comparatively small cost, an old house has been purchased, altered, and equipped, and the site on which it stands will allow of extension to the premises without any difficulty. If ever there was a case of money being well-spent, this is surely one.

Water Heater Design

WE continue to-day publication of a treatise on the design of gas-fired water heaters, with special reference to heat transfer, by Mr. T. G. Noble, of the Gas Light and Coke Company. A vast amount of information on this important subject is set out by the author in a clear manner, and he includes a lengthy bibliography which will prove most useful to those who are studying the problem. The whole contribution is yet another example of how the work of those within the Gas Industry can help the manufacturers of appliances and be of all-round value. In this respect the advances made during the past few years are increasing the potentialities of our Industry enormously, and giving a flexibility of outlook essential to modern competitive conditions.

Mr. Noble suggests there is a misapprehension as to the function of the designer in regard to heat transfer. It is certainly not to strive for thermal efficiency at all cost. "In point of fact," he says, "there is little difficulty in producing a water heater of almost any desired thermal efficiency if due regard is not paid to other factors—simplicity of construction, ease of installation and maintenance, general reliability and utility, simplicity and safety of operation, cleanliness, cost, appearance, and so on—of greater importance to consumer and gas undertaking. That this is fully realized by many designers is obvious; that it is overlooked by others is equally so." His treatise will, we suggest, be of considerable help in focussing attention on the desiderata of water heater design.

It may serve a useful purpose if we call attention here to one of the fundamental points discussed by the author and to his suggestions as to possible improvement in design. We refer to the influence of the film of stagnant gas on the gas side of a water heater. The existence of such a film is, of course, well known, but the magnitude of its effect on transmission of heat from hot gases

to water is insufficiently appreciated. For any effective increase in heat transmission to occur the surface conductance on the flue gas side must be appreciably increased. It is idle to attempt to increase heat transmission by increasing the conductance of the metal wall —for example, by using thinner metal or metal of higher thermal conductivity—or by adding fins to the water side, or by controlling the flow of water through the appliance. What we have to do is to minimize the effect of the stagnant gas film; and among other methods mentioned by Mr. Noble is the application of streamlining to the design of water heaters. He suggests that streamline tubes could with advantage be embodied in existing designs of central heating unit, and that efficiency could be improved by the use of streamline pips in place of those of circular section employed in some cast heating units. As to the use of baffles in the flueways to create turbulence, Mr. Noble has come to the conclusion that many baffles employed in gas appliances are quite unnecessarily complicated in design.

Suggested Improvements

It is suggested that, in regard to the amount of heat transferred by radiation from the hot gases to the water, though from other considerations designers have been led to build in a way to favour such transference, they have not always taken full advantage of the possibilities of extending the combustion chamber beyond the minimum essential to good combustion. Concluding his section, "Heat Transfer—Design for Compactness," Mr. Noble speaks of the possibility of securing high efficiencies together with hot dry flue gases by bringing about a maximum of condensation in the appliance and passing the cooled saturated gases over a heat exchanger, whereby the flue gases are re-warmed and become unsaturated. Other possible improvements are the use of a radiant by-pass unit and the design of flue surfaces giving a greater by-pass efficiency. "The difficulties to be overcome are considerable, but so is the potential reward in increased overall efficiency and service to the consumer."

We are glad that the author has in mind throughout overall efficiency and does not concentrate on thermal efficiency as such. He asks for thermostats easier of disassembly for internal cleaning, and, above all, of better external appearance; and we are in hearty agreement with him in his demand for a greater measure of automatic ignition. It is surprising that few water heaters are equipped with ignition devices. Water heating has not such severe competition to meet as some of the other loads, but that is no reason for postponing the inclusion of automatic ignition. Again, Mr. Noble calls for more enterprise in choice of materials and finish, and looks forward to the time when we shall be delivered from "the bondage of copper and 'cast.'" There are indications that experiments in this direction can be commercially successful as well as scientifically interesting. Finally, as to appearance, there can be no best design from this point of view, since it will depend on surrounding decorations and fittings. The opinion is advanced that architects and owners will increasingly demand unity of design for the various pieces of equipment commonly required to be housed in the same room. "At present we sell appliances of different kinds with finishes which match or contrast well; but more than this will be necessary in the near future. It should not be impossible to secure better co-operation between the manufacturers of the various individual types and between all manufacturers and leading architects and designers."

A Memorable Gathering

The twenty-fifth anniversary of Co-Partnership in the Gas Light and Coke Company was celebrated last Thursday by a Dinner at the New Horticultural Hall, Westminster. It was a memorable gathering—a gathering expressive of the mutual confidence and respect which the spirit of Co-Partnership engenders.

The Gas Light and Coke Company was not, of course, the first to adopt a Co-Partnership Scheme, but the very size of the Company magnifies the influence of Co-Partnership. In the twenty-five years since 1909, the number of co-partners has grown from 9,000 to 17,000, and co-partners hold practically £1,000,000 of the Company's stock.

In addition to co-partners present at the dinner there were no fewer than 154 long service and pensioned men whose aggregate service amounts to 6,600 years—truly a remarkable record. Also remarkable is the record of the thirteen men who during the course of the evening received long service presentations. Between them they have 640½ years' service with the Company, and five them have over 50 years each. We have no doubt that Co-Partnership, carried out in spirit and in letter, has helped to maintain this faithful service.

The occasion was honoured by the presence of Viscount Cecil of Chelwood, who in an inspiring speech expressed his firm belief that the future well-being of the individual, of industry, of the Nation, and of international relations depends upon the exercise of the principles of co-partnership. A report of the dinner will be found on later pages.

The "Flat Load"

We have referred in recent issues of the "Journal" to gas installations in the type of working-class tenement building which is springing up in many of our large towns. The blocks of flats such as we have described are definitely providing a higher standard of living as well as a lighter and brighter outlook for many families who, up to the present, have not had the opportunity of knowing anything of scientific home planning, nor, indeed, in all too many instances, of even reasonably hygienic surroundings.

The object of those responsible for the erection of these flats is, of course, to provide as many as possible of the essential domestic services ready installed—the interest on the capital costs being included in the weekly rents. Very keen competition therefore exists for the contracts involving the supply of lighting, heating, cooking, and water heating appliances, which may well, in the aggregate, run into many hundreds for a single block of flats.

We have had the opportunity of inspecting one or two examples of these modern blocks of dwellings, and several points are brought home very forcibly. First and foremost, instances occur—though fortunately rarely—of blocks being erected without a single flue, while in others there is but one flue (in the living room) to each three, four, or five roomed dwelling. The Industry must continue to agitate, in season and out, against such perpetuation of unhealthy conditions. A further problem is introduced as a result of the solid concrete construction of many of these buildings, which does not allow of concealed supply pipes being run to additional appliances which tenants may desire, so preventing a neat job being made of any further piping. Furthermore, faults developing in pipes embedded in solid concrete cannot be rectified without considerable trouble.

The immense possibilities of the water heating load are exemplified in an article in this issue. Gas cooking is, we are glad to say, also fairly universally adopted for this type of property. It is the lighting load, however,

which in many cases still hangs in the balance. An offer to provide complete lighting equipment, *switch controlled throughout*, will often turn the scales in favour of gas, which cannot but prove more suitable economically, as well as in every other way, to the class of consumer who has to use it.

The erection of these blocks of flats, therefore, provides a great opportunity for the Industry. The slum dwellings which are being displaced usually had gas for lighting as well as various other purposes, and this lost load must be replaced. The fight for the flat load, however, is only just beginning, and it is usually a matter of getting in at the start or not at all.

Gas and the Coal Industry

APPEARING a few days ago under the heading of "Domestic Heating" was a letter addressed to the Editor of the *Financial Times* by Messrs. N. Grattan Doyle and Joseph A. Leckie, who wrote from the House of Commons. A simple heading, and in some ways a simple letter, though in one respect tending to perpetuate what we must point out is a mistaken view of the situation. The National Smoke Abatement Society have devoted infinite pains, as well as an incalculable amount of slogging hard work, to demonstrating the advantages of gas from the view-point of the welfare of the community as a whole; but the reasoning upon which is based the opening sentence of the letter on "Domestic Heating" is that the mining industry will be better helped by the use of raw coal, which is another story, though one that should not in the slightest degree prejudice gas. The sentence reads: "When the coal-mining industry of this country is enduring much hardship, it seems undesirable that the domestic uses of coal—the most popular and economical form of heating—should be ignored." May we express wonder as to how long it will be before those who give voice through the columns of the newspaper Press to their sympathy with the coal industry in its tribulations realize that the Gas Industry is one of its biggest customers? Why must people be continually urged to consume coal in its dirtiest, most inconvenient, and least desirable condition—that is, in its raw state—when the thermal energy extracted from the self-same coal, in its purified form, is placed on tap by the gasworks of the country? This is just one of those little points that district representatives of gas undertakings must keep hammering away at. No one should be permitted to labour under a mistaken belief that coal and gas are antagonistic; Old King Coal has no firmer friend than gas, whose help is invaluable in keeping him upon his feet.

Then Messrs. Doyle and Leckie, proceeding upon the assumption that "it is perhaps only natural that architects should prefer to design for gas and electric heating, for these offer a greater variety of treatment," go on to urge that in planning the many thousands of dwellings to be erected to re-house people from slum areas, the architect "should consider the national interest rather than his own natural instinct, and design houses really suited to their prospective tenants." What is in question is "the architect's ability to face realities." The architects are well able to look after themselves; our concern is that the general public should be perpetually reminded that by using gas they are helping the coal industry—they are, in fact, so consuming coal as to secure all its advantages with none of its disadvantages. If we are to maintain gas in its proper position there is need for constant reiteration of this and other elementary facts. The "national interest" points to the use of gas.

The general rule in council houses of providing one coal grate for the living room and gas fires in positions calling for intermittent use, is, perhaps, the most that can be hoped for under prevailing conditions of cost, but we should have as our ultimate aim the elimination of this one coal grate, rather than the substitution of coal for gas in the remaining rooms. Messrs. Doyle and Leckie admit that for occasional use, or as alternative forms of heating, both gas and electricity are of value, and when they had cause some months ago to obtain from a number of housing authorities the facts regarding the form of heating used in council houses, they found that in only two of the cases had such schemes been carried through with gas or electricity as the sole heating agent, and ultimately both boroughs were compelled to install coal-fed grates, as tenants were unable to bear the cost of the system provided. So long as the argument is based upon relative cost, we can have nothing to say regarding it except that the labour-saving and cleanly attributes of gas should be reckoned in as potent factors in reduction of its cost. What, however, we do wish to see removed is every vestige of feeling that, even from the coal-mining point of view, it is less patriotic to use gas produced from coal than it is to use the raw coal itself. When new tariffs come along which will place the cost of gas heating upon a different footing, it will be all important that the public should have this matter rightly fixed in their minds.

Forthcoming Engagements

December.

13.—NATIONAL GAS COUNCIL.—Meeting of the Central Executive Board, at 28, Grosvenor Gardens, S.W. 1, 2.30 p.m.

13.—S.B.G.I.—Council Meeting, 2.30 p.m.

14.—SOUTHERN ASSOCIATION.—Western District Commercial Meeting, Rougemont Hotel, Exeter, 2.30 p.m.

14.—LONDON AND SOUTHERN JUNIOR ASSOCIATION.—Meeting and Paper by Mr. G. P. Manning.

15.—WALES AND MONMOUTHSHIRE JUNIOR ASSOCIATION. Meeting at Cardiff. Paper by Mr. G. S. Leonard.

15.—YORKSHIRE JUNIOR ASSOCIATION.—Meeting in Sheffield. Presidential Address of Mr. R. Halkett, Jun.

19.—B.C.G.A.—Meeting of Executive Committee, 28, Grosvenor Gardens, 11 a.m.

January.

3.—MIDLAND JUNIOR ASSOCIATION.—Meeting at Nottingham and paper by Mr. W. L. Howe.

12.—WESTERN JUNIOR ASSOCIATION.—Visit to Yeovil and paper.

12.—SCOTTISH JUNIOR GAS ASSOCIATION.—Joint Meeting at Glasgow. Paper by Mr. Stephen Lacey, of London.

19.—WALES AND MONMOUTHSHIRE JUNIOR ASSOCIATION.—Meeting at Portheawl. Paper by Mr. G. Thomas.

19.—YORKSHIRE JUNIOR ASSOCIATION.—Meeting at Sheffield. Paper by Dr. Fritz Gummert (Director of the Ruhr Gas Company).

23.—B.C.G.A.—Manchester District Meeting, Manchester.

24.—B.C.G.A.—Yorkshire District Meeting, Leeds.

25.—B.C.G.A.—Northern District Meeting, Newcastle-on-Tyne.

25.—LONDON AND SOUTHERN JUNIOR ASSOCIATION.—Meeting and paper by Mr. S. F. Dunkley.

31.—B.C.G.A.—South-Western District Meeting, Exeter.

February

7.—B.C.G.A.—Eastern District Meeting, Cambridge.

14.—B.C.G.A.—Midland District Meeting, Birmingham.

Personal

Mr. B. LONG, Secretary and Commercial Manager of the Horley District Gas Company, has been appointed General Manager and Secretary.

* * *

Mr. JOHN ROBERTS, of Bingley, has now been appointed Engineer and Manager at Ripon and will commence his duties in the New Year. For the past seven years he has been Assistant Manager to the Bingley Gas Department.

* * *

At the last meeting of the Gas Committee of the City of Stoke-on-Trent, Alderman G. H. BARBER, J.P., was appointed Chairman and Councillor A. LOCKETT Vice-Chairman of that Committee.

* * *

Mr. R. E. TAYLOR, Engineer and General Manager of the Haslemere and District Gas Company, has been appointed Managing Director of that Undertaking, which has recently come under the control of Associated Gas and Water Undertakings, Ltd., a holding Company operating in connection with the East Surrey Gas Company.

* * *

There was a happy event at the Town Hall, Hereford, on Saturday afternoon, when the staff and employees of the Hereford Corporation Gas Department gathered together for tea in order to make a presentation to Alderman CHARLES WITTS, to commemorate his fifty years' service to the City as a member of the Council, and his long association with the Gas Department as a member, and then as Chairman of the Gas Committee. Mr. A. R. W. Roberts, Gas Engineer, made the presentation of an easy chair, and in doing so recalled the fact that Alderman Witts became a member of the Gas Committee in 1886, and became its Chairman in 1905. Mr. Roberts commented upon the keen interest Alderman Witts had always taken in the gasworks and said that during his Chairmanship the whole of the works had been practically re-designed and rebuilt.

* * *

The Institution of Gas Engineers announce that Mr. W. T. K. BRAUNHOLTZ, Ph.D. (Cantab.), M.A., F.I.C., has been appointed to the position of Technical Assistant Secretary to the Institution. His duties commence on Jan. 1, 1935.

* * *

We are informed that Mr. CHARLES L. LEE, A.C.A., A.S.A.A., has been elected a Director of the Bilston Gas Company.

Obituary

Lord RIDDELL, whose death was announced last week, was President of the Society of British Gas Industries from 1921-23, having been asked to accept office for a further term after the expiry of his normal year's Presidency. He was a Vice-President of the Society up to the time of his death.

News In Brief

The Colonial Gas Association, Ltd., of Melbourne, have kindly forwarded us two specimens of literature published in connection with the special All-Australia Centenary Exhibition.

To Mark the Tercentenary of Anstruther Easter Parish Church on the Firth of Forth coast, the tower of the church was floodlighted by the Anstruther and Cellardyke Gas Company last week.

Welding of Iron and Steel.—A symposium on this subject will be held at the Institution of Civil Engineers on May 2 and 3, 1935, in conjunction with the annual meeting of the Iron and Steel Institute.

Carefree Greenhouse Heating is the subject of an article in the issue for Dec. 15 of *Amateur Gardening* dealing with the advantages of gas for this purpose, especially for the use of the amateur.

All Four Prizes in the cake-baking competition at the cookery demonstrations recently held by the Ludlow Union Gas Company, Ltd., were won by users of a "New World" Regulo-controlled gas cooker.

A Price Reduction has been effected by the Berwick and Tweedmouth Gas Light Company, Ltd., of 2d. per 1,000 c.ft. as from the next reading of meters. The price of gas for street lighting has also been reduced.

The Conservation of Coal was the subject of an address to members of the newly-formed Co-operative Men's Guild at Accrington on Dec. 6 by Mr. A. J. Harrison, Engineer and Manager of Accrington District Gas Board.

New Middleton Premises.—Middleton Town Council has approved a proposal by the Gas Department to convert premises in Long Street, previously bought for £2,000, into showrooms and offices at a further cost of £3,000.

Applications are Invited for the post of Assistant Engineer and Manager to the Bingley Gas Department. The appointment carries a commencing salary of £240 per annum, rising to £300 by annual increments of £12.

The Twenty-Fifth Annual Exhibition of scientific instruments and apparatus, arranged by the Physical Society, will be held on Jan. 1, 2, and 3, 1935, at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, S.W. 7.

Gas Charges were considered at a special meeting of the Salford City Council held on Wednesday, Dec. 12. The matter had arisen following the decision of the Council to abolish the meter rental charge. This deprived the Gas Undertaking of an annual income of roughly £15,000, and the Committee are anxious to find some means of consolidating their resources.

Gas Steam Raising.—The Blackburn Gas Committee have approved terms for a supply of gas to Messrs. C. A. Bancroft & Co., shuttle makers, Blackburn, for a gas-fired boiler for steam raising purposes.

A Qualified Engineer is required by the Borough of Morecambe and Heysham Gas Department to act as Clerk of Works and generally superintend the erection of a new 1½ million c.ft. spirally-guided gasholder. The engagement continues for the period of the erection and carries a salary at the rate of £350 per annum.

Tenders are Invited from approved engineering contractors for additional plant by the Doncaster Corporation Gas Department. The provision of extra plant has become necessary since a large amount of gas is now required to supply the London and North-Eastern Railway Company's extensive works at Doncaster.

An Extension of Limits of Supply is among the powers sought by the Torquay and Paignton Gas Company in a Special Order Application. Other objects include the authorization of the Company to charge differential prices within the added limits, and to confer upon them all or any powers commonly conferred on gas undertakings.

To Assist Local Publicity the B.C.G.A. have issued a further excellent little booklet giving examples of the latest advertisement layouts available for gas undertakings. The various types of display for all forms of domestic appliance publicity will be found very helpful to undertakings in promoting their own local press advertising.

A New Company with the title of the Association Intercommunale pour la Distribution du Gaz (Intergaz) and having a capital of one million francs has lately been formed at Molenbeek-St. Jean to supply gas in the Belgian Province of Brabant. Gas will also be distributed in the areas at present supplied by the Société Electrogaz and the Imperial Continental Gas Association at Watermaal-Boitsfort, Koekelberg, Molenbeek-St. Jean, and Etterbeck.

"Modern Lifting."—This is the title of an excellent publication by Messrs. Herbert Morris, Ltd., Loughborough, who manufacture a vast range of lifting and shifting machinery available to manufacturers, merchants, railways, and others engaged in trade or industry. In the past it was the practice of this firm to publish small handbooks for posting to their friends every two months but requests for some form of binding case from many quarters have led to the publication of this large comprehensive volume. It is copiously illustrated with interesting examples of many and varied types of conveyors, cranes, &c.

T. & R. W. Bower (Illingworth) Carbonization, Ltd.—In the Companies Court recently, Mr. Justice Eve had before him a petition by T. & R. W. Bower, of Darlington, for the compulsory winding up of the above Company. It was stated that there was a petition by creditors for over £10,000 and interest. The Company did not appear and His Lordship made the usual compulsory order.

The Institute of Fuel.—A meeting of the North-Western Section of the Institute of Fuel was held on Wednesday, Dec. 12, 1934, at 7 p.m. at the Engineers' Club, 17, Albert Square, Manchester. This meeting was devoted to the exhibition of films, including "The Manufacture of Coal Gas," by kind permission of the Croydon Gas Company, and "Coal Washing," by kind permission of Messrs. Simon-Carves, Ltd.

Vienna's Good Progress.—The completion of the first 35 years' existence of the Municipal Gas Department of Vienna, Austria, was recently celebrated. During the past ten years the average daily production of the Works has been increased from between 33 and 34 million c.ft. to nearly 45 million c.ft. During the same period the storage capacity has been raised from 32 to 42 million c.ft. and the length of the distributing mains from 995 to 1,050 miles.

The Annual Dinner of the staff of Bradford Gas Department was held on Dec. 1, at the Great Northern Victoria Hotel, when Mr. G. E. Currier, Engineer and Manager, presided over a large and happy gathering. Among those present were Alderman F. J. Cowie, Chairman of the Gas Committee; Councillor Alton Ward, Deputy-Chairman; ex-Alderman George Walker, J.P., former Lord Mayor and for many years Chairman of the Gas Committee; Mr. Charles Wood; and Mr. E. J. Sutcliffe.

Darlington's Good Work.—At a meeting of Darlington Town Council held recently, it was reported that in the Gas Department during the year to date more gas had been sold than ever before. The previous record was in 1928. The value of gas appliances sold and the number of orders received were also a record, being 22% and 20% increases respectively. A loss of £93 on the cost of running the showroom had been turned into a profit of £243 this year.

The Chief Object of a Special Order Application by the Sheffield Gas Company to the Board of Trade is to acquire the control of the Matlock and District Gas Company. The Order makes provision for the payment of a sum of money by the Company to be applied in payment of compensation for loss of office. Other objects include an extension of limits of supply so as to include the added area and to authorize the Company to have and exercise within these added limits such powers which they now possess.

Successful Cookery Demonstrations.—Last week Mr. J. Jamieson, Engineer and Manager of the Edinburgh Gas Department, told the Town Council that at the recent gas cookery demonstrations held in the Department's showrooms 3,862 people had attended the cookery demonstrations in 10 days. In future larger premises would be necessary, as they had been forced to exclude some 2,000 people. During the period from a week before the demonstrations to a week after, 369 gas cookers had been sold or given out on the hire-purchase system, compared with 178 for the same period in 1933.

Fourteen British Experts, whose daily task is to teach people how to cook, have written a booklet called "Christmas Fare" (*A Thousand-and-One Uses for Gas*, No. 248). Over fifty recipes are given, the preparation of every dish being described in detail, while numerous illustrations emphasize the instructions. It is a practical book for the average housewife, and does not deal with expensive dishes that are beyond the means of the ordinary household. "Buy the turkey to fit the oven" is one piece of sound advice among a hundred others. Copies may be obtained from the B.C.G.A., 28, Grosvenor Gardens, S.W. 1.

Gas Production in Holland.—The recently-issued Annual Report for 1933 of the Director of the Municipal Gas Undertaking of Rotterdam shows that for the first time the amount of gas delivered from the Works underwent a slight decline, an aggregate of approximately 2,843,787,000 c.ft., having been attained against 2,881,216,000 c.ft. in the preceding year, a decrease of about 1·3%. The total output of the Works during the year reached an aggregate of 3,193,952,000 c.ft., of which 80·4% was coal gas and 19·6% water gas. The coal gas output represented a yield of 13,534 c.ft. per ton of coal carbonized. The number of gas meters in use increased during the twelve months from 148,994 to 152,172.

Over 1,100 Persons attended the Cookery Demonstrations held for a week by the Chesterfield Gas Department recently. Miss Crossland, of Radiation Ltd., gave the cookery lectures, in conjunction with which a competition was held, while washing demonstrations were given by Messrs. W. H. Dean & Son, Ltd.

A Bill to Consolidate with amendments the provisions of the Bognor Gas and Electricity Acts and Orders, 1908 to 1927, relating to their capital and borrowing powers has been applied for to Parliament by the Bognor Gas and Electricity Company. Among other objects the Bill is to authorize the Company to raise additional money and to confer further powers on them.

Organized by the Donaghadee Gas Company, an attractive exhibition ran throughout last week in the Railway Pavilion. At the opening ceremony Mr. Henry M'Keag, J.P., presided, and Major Brush, the Town Commissioner, performed the opening ceremony, paying tribute to the efficiency with which the affairs of Donaghadee Gas-Works are managed under Mr. W. H. Roberts, who has the assistance of his two sons. He recalled that, since the Roberts family took over, the output of gas had risen from 3 to 17 million c.ft. per annum.

The Proposed Purchase of the Sunderland Gas Company by the Sunderland Corporation is not likely to be discussed any further. A special Committee appointed by the Town Council to consider purchase of the Gas Undertaking had previously recommended that, as the Company had no desire to sell, the project be dropped, but the Council decided that an offer should be made. The Corporation consulted Mr. W. A. Valon, London, and acting on his report they made a tentative offer of £450,000 to the Company. The Company has now declined this offer, and the special Committee now recommends that no further action be taken.

Gas Production in Amsterdam.—From the recently-issued annual report for 1933 of the Municipal Gas Undertaking of Amsterdam we learn that, following a slight decline of 2·2% in 1932, the sales of gas during the twelve months reached a total of 3,937,002,000 c.ft. compared with 4,062,371,000 c.ft. in the preceding year, a further decrease of 3%. The Undertaking owns two works—the Wester and the Zuider—and two distributing stations which, together, possess nine gasholders with a total storage capacity of 11,289,000 c.ft. The number of gas meters in use in the city increased by 1·44% during the twelve months from 204,900 to 207,843.

A Large Increase in Output has led the Stoke-on-Trent Gas Committee to consider the question of installing additional manufacturing plant at the Etruria Gas-Works. Although the works are comparatively new, an addition to the existing plant will be required on account of the heavy increases in the demand for gas, which for the seven months April to October, 1934, have amounted to over 91 million c.ft. more than for the corresponding period last year. This increased demand is due to the extended use of town gas for industrial purposes, and this is encouraged by the low selling price of gas and the efforts of the Department's staff in obtaining new business.

The Import Duties Advisory Committee have under consideration the question of rendering illuminating glassware generally subject to an import duty of 3d. per lb. or 20% *ad valorem*, whichever is the greater. They further give notice of an application for an increase in the import duty on compound fertilizers, mixed fertilizers and compound manures in powder or granular form, imported in bags or in bulk. Any representations which interested parties may desire to make in regard to these commodities should be addressed in writing to the Secretary, Import Duties Advisory Committee, Caxton House (West Block), Tothill Street, Westminster, S.W. 1, not later than Dec. 22 next.

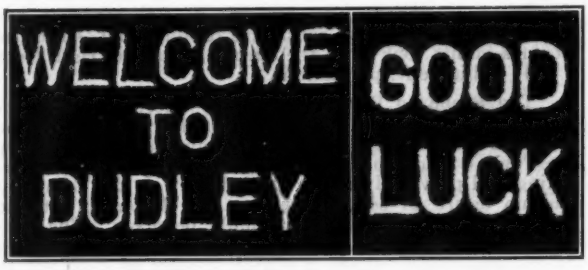
A Good Impression was left with the Rover Sea Scouts of Lymington who recently spent an instructive evening in going over the Local Gas-Works, the following account of which appeared in *The Galleon*, the Scouts' periodical: "We had as our guide the Gas Company's popular Manager, Mr. J. W. Gibson, who had gone to the trouble of preparing notes for each of us, to help us understand the manufacture of gas which is so indispensable in modern life. Each stage was explained and demonstrated to us, and we were given the opportunity of filling one of the huge retorts. We were expecting to find the whole place covered with coal dust, but were disillusioned about this; order and cleanliness appear to be the passwords. The workshops were a revelation to us. Mr. Gibson told us that the fitters could enter the workshops in complete darkness and pick up any tool they wanted."

The Gas Salesman's Pocket Book.

Readers are reminded that the 1935 edition of the "Gas Salesman's Pocket Book" will be published this week, and that prompt orders will ensure early delivery. The record circulation of the 1934 edition—a circulation already far outstripped—enabled not only a widening of the scope of this reference book, but also a reduction in price. The price for a single copy is now 3s., and there is an attractive sliding-scale which rapidly lowers the price to 2s. per copy for quantities.

At a lower cost, the 1935 Pocket Book contains more information than ever—up-to-the-minute information unobtainable elsewhere in such handy reference form.

Gas Signs Welcome Royal Pair.



The Dudley, Brierley Hill, and District Gas Company were the first to welcome the Duke and Duchess of Kent to Dudley after their wedding and to speed them on their way to Himley Hall by means of the gas signs illustrated above. Himley Hall is only a few miles out of Dudley and is in the Company's area of supply. These signs consisted of letters 2 ft. high which were made and erected by the Company's workmen.

Amalgamation and Grouping.

Associated Gas and Water Undertakings, Ltd.

Associated Gas and Water Undertakings, Ltd., announce that they have recently secured a controlling interest in the Haslemere and District Gas Company, the Horsham Gas Company, Ltd., the Midhurst Gas Company, Ltd., the Edenbridge and District Gas Company, the Westerham Gas and Coke Company, Ltd., and the Kirton-in-Lindsey Gas Light and Coke Company, Ltd.

Manchester and District Junior Gas Association.

Visit to the Works of Donald Macpherson & Co., Ltd.

A large number of the members of the Manchester and District Junior Gas Association visited the works of Messrs. Donald Macpherson & Co., Ltd., at Manchester on Wednesday, Dec. 5.

Parties were conducted over the Works by guides, who explained the various processes of manufacturing paint and varnishes from the raw material to the finished "Foochow" products. A practical demonstration was given of spraying cookers, fires, and fittings, to make them harmonize with every colour scheme.

At the conclusion of the inspection the members were entertained at tea at the Victoria Hotel on the invitation of the Directors of the Company, after which the PRESIDENT (Mr. James Carr) referred to the services rendered to the Association by the late Mr. Massey, and he asked the members to stand in silence to his memory. He then proposed a vote of thanks to the Directors of Messrs. Donald Macpherson & Co., Ltd., for permitting the members of the Association to visit their Works and also for their kind hospitality. Mr. Carr congratulated the Directors on the scientific manner in which their products were manufactured.

Mr. ALFRED L. HOLTON (Manchester), in seconding the vote of thanks, said that he was pleased to note the large part that chemical control played in their organization. He was particularly impressed by the general layout and efficient manner in which the various processes were carried out. The size of the works would be a revelation to many, as would also be the variety of "Foochow" products, which covered a far wider field than the Gas Industry.

Messrs. W. A. LOWE and S. W. CHESTER (Directors) responded on behalf of the Company.

Mr. W. A. LOWE then read a paper entitled "The Application and Use of Colour for Attractive Modern Gas Appliances." This paper, together with our report of the discussion, will be found on other pages of this issue.

Scottish Junior Gas Association (Eastern District).

Visit to the Tay Works of Messrs. Peebles.

On Saturday, Dec. 1, over 50 members of the Scottish Junior Gas Association (Eastern District) visited Messrs. Peebles & Co., Ltd., Tay Works, Bonnington. They were met by Col. W. Carmichael Peebles and members of his staff, who had arranged to conduct parties over the works, which had been kept in operation for the special benefit of the Association.

Col. Peebles welcomed the Association on behalf of his co-Directors.

Working demonstrations of most types of governors and meters had been arranged, and these, with sectional models and diagrams, gave the members a full opportunity of appreciating the action and working of the appliances, and the high standard of engineering to be found in all the products. Some of the features noted in the gas meter section were the patent method of securing the Persian sheepskin diaphragms to the diaphragm plate by an endless spiral spring which ensures an even tension at all times and forms a perfectly gas-tight joint. One of the original springs has had a 10-lb. weight suspended from it since 1925 and has not shown any sign of loss of elasticity. Cork saturated in graphite and oil is used in the stuffing boxes, and these have proved to offer less resistance and wear to the spindles than ordinary stuffing wools, and also to withstand high pressure and still remain gas-tight.

Single, duo-coin, and optional prepayment fittings were seen in all stages of manufacture, and their simplicity of action demonstrated. Finally, the finished meters were shown under test in the official testing room, only 2 and 3 tenths being absorbed by the medium and high-capacity meters at full load. Gas governors of every conceivable type and kind from those for the small single burner constant volume governors for street lamps to large station and district governors using weight, water, pressure, clock, or self-loading type, both high and low pressures, were seen.

A new modification of the B.V.R. retort house governor is the C.V.R. in which a cylindrical valve is used in place of the butterfly valve, and water in place of air for operation. This arrangement ensures steadier action, and is less subject to variations of exhauster pull. The use of clock loading by means of cams designed to give the variation in pressure required throughout the 24 hours, with a separate cam which is automatically brought into use for Sundays, evoked much interest. Of small governors for lamps, cookers, geysers, &c., there was a great variety giving either constant volume or pressure, but one which attracted attention was an automatic cut-off for use with prepayment meters. Its function is to cut off the gas supply on the outlet of the meter if the meter has cut off the gas due to the prepaid amount of gas having been consumed, in the absence of the consumer, and the appliance having gone out with the gas tap turned on. The supply cannot be re-established by the consumer inserting more coins in the meter until this "cut-off" governor has been re-set by pressing a small button on the governor. This requirement will ensure that the appliance is turned off before more gas is sent forward, and so avoid any danger from unburnt gas passing into the house. Pressure gauges, jet photometers, and heat indicators and recorders were also inspected.

After the visit, the members were conveyed in motor 'buses to a restaurant in Edinburgh, where high tea was served. Col. Peebles, in a few remarks made after tea, expressed the hope that the members had enjoyed their visit and that the younger members now understood how the various appliances operated. He said that he was very particular to ensure a high standard of workmanship in their products. He emphasized the necessity of paying particular attention to details.

Mr. Sydney Smith, President of the Association, replied on behalf of the members, and thanked Col. Peebles and his staff for providing what had proved to be one of the most interesting visits of the Association. The name of Peebles was a household word in the Industry, and their appliances were to be seen in every works.

The vote of thanks was acknowledged by Col. Peebles.

Exterior View.

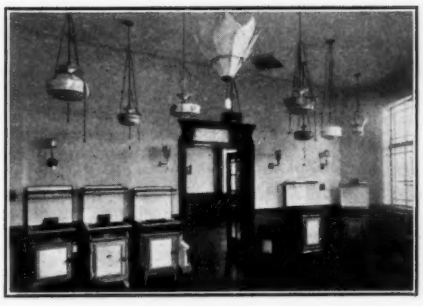
NEW SHOWROOMS AT SKEGNESS

Counter and Staircase.

Attractive new showroom premises were opened for the Skegness Gas Department on Nov. 12 by Councillor F. Wood, J.P. (Chairman of the Urban District Council), and Dr. B. Sweeton, J.P. (Chairman of the Gas Committee).

The premises, which were constructed from plans and designs prepared by the Nautilus Company, of Luton, occupy an important corner site in the centre of the town, at the junction of five roads and opposite the railway station. Large display windows with bronze frames flank the main entrance, and the lighting of the exterior is carried out by eight 6-light "Rochester" lamps in coin bronze, by Messrs. William Sugg & Co., Ltd., while there are, in addition, two bracket lanterns and a porch lamp, by Messrs. Evered & Co., in the entrance. The illumination of the clock face is effected by two further "Rochester" lamps of special design and automatically controlled. Sixteen directive lamps provide the interior window lighting.

The main showroom on the ground floor, which is about 25 ft. square, is panelled to a height of 8 ft. in Australian oak, and includes a counter for inquiries and payment of accounts, behind which is an office for the staff. There is also a kitchen recess with a cooker illuminated by a concealed light in the ceiling of the recess, together with a water heating recess containing various types of appliances which discharge into stainless steel troughs. A display pedestal fitted with various coloured surrounds occupies a central position for the display of four gas fires.



Cooker and Lighting Section.

Another View of the Main Showroom.

On the first floor, which is approached by the staircase seen in one of the accompanying photographs, is a Lecture Hall with accommodation for 100 people. This has a demonstration platform complete with recessed sink which may be concealed by means of sliding panels. This room is lighted by two ventilating lamps, platform lamps, and wall brackets, while the colour scheme is in cream and brown. There is a further showroom on this floor, primarily intended for the display of lighting fittings and gas radiators, though additional cookers, fires, and boilers are also set out. The decoration scheme here is in light and dark green.

During the opening week of the new showrooms a series of cookery demonstrations by Miss Williams, of Radiation, Ltd., proved of great interest, while washing displays which have subsequently been held in the display window have also attracted much attention.

Gas Development Association for Women.

Halifax Centre Visit Bradford.

A party of 45 members of the Halifax Centre of the Gas Development Association for Women, journeyed to Bradford by special motor coaches on Dec. 4, to visit the new showrooms of the Bradford Corporation Gas Department at Britannia House and the big departmental store of Brown, Muff, & Co., Ltd., where the entire heating and the cooking of the extensive building for both the public restaurant and the staff canteen are done by gas.

At the Bradford showrooms the party were welcomed by members of the Bradford Undertaking and at Messrs. Brown, Muff's store by the Directors and staff. The party had tea in the Company's café and found a great deal of interest in touring the many departments, both in respect of the gas appliances and the attractiveness of a great store packed with Christmas displays.

The Halifax Centre, the pioneer of this country, was founded last January and will celebrate its anniversary by a special social gathering on Jan. 16 in the Halifax Gas Showrooms. The Centre now has a membership of 96 and meetings are held on the third Wednesday of each month. In addition periodical special visits, such as the trip to Bradford, are arranged. The Mayoress of Halifax is the President of the Centre, this duty being first undertaken by Mrs. F. A. Leach, who was Mayoress at the time of the inception of the movement. On change of Mayoralty last month Mrs. Leach became an honorary vice-president. The new Mayoress (Mrs. Laurie Lightowler) is now the President, and an honorary Vice-President is the present Lady Mayor of Halifax (Mrs. Miriam Lightowler). Practically all the leading ladies in the Centre are well-known workers in various phases of public life. The membership includes four ex-Mayoresses of the Borough.

Industrial Display at Cardiff.

Photo. by "Western Mail."

The above photograph is of the Cardiff Gas Light and Coke Company's Industrial Display at the recent South Wales Institute of Engineers' Exhibition at the Greyfriars Hall, Cardiff, to which we referred in the "JOURNAL" for Nov. 28.

Gas Exhibition at High Wycombe.

A successful Exhibition of modern gas appliances was recently held by the Uxbridge, Maidenhead, Wycombe, and District Gas Company at High Wycombe. The attractive arrangement of the Exhibition created considerable public interest, and the mechanical "Minette" cooker display loaned by the Parkinson Stove Company proved a very novel feature.

Co-Partnership Coming of Age.

East Surrey's Continued Progress.

The East Surrey Gas Company's Co-Partnership Scheme attained its majority this year and there were many justifiable congratulations at the Annual Meeting of co-partners held at the Market Hall, Redhill, on Thursday, Nov. 29. The scheme has made remarkable progress since its inception, and stock held by co-partners on June 30 last amounted to £15,640. During the year investments amounted to £2,194 and savings to £660. Mr. G. R. Hunt, J.P., has been Chairman of the Committee since its inception, and at the Meeting the co-partners gave tangible evidence of their warm appreciation of his interest in the scheme by presenting him with a suitably inscribed handsome clock.

Presentation of Certificates.

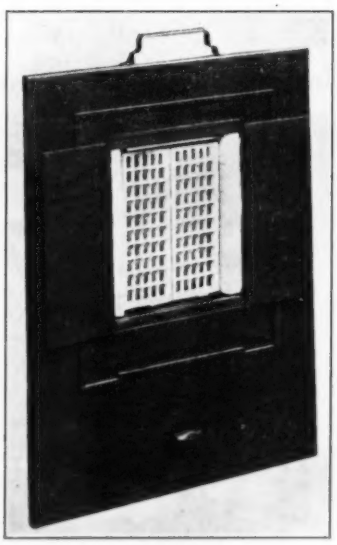
Another interesting feature of the Meeting was the presentation of certificates and prizes awarded in connection with the technical classes for the session 1933-34. These awards were gained in the Examinations of the Institution of Gas Engineers, the City and Guilds of London Institute, the London County Council School of Building, and the Surrey Education Committee County Examinations. There were no fewer than 34 recipients.

Supporting Mr. G. R. Hunt in the chair at the Meeting were the following Directors of the Company: Messrs. W. Lees Stenning, J.P., Chairman, W. H. Bennett, Managing Director, H. Stacey, J.P., R. H. Mew, and J. Urquhart, together with Messrs. H. Long, F.C.I.S., Secretary, E. Scears, Engineer, and A. Tennant, Sales Manager, and co-partners from Redhill, Reigate, Godstone, Lingfield, Walton-on-the-Hill, Capel, and Dorking.

Notes on Plant and Processes

A Two-Unit "Portcullis" Screen Fire.

In response to a demand from both gas undertakings and the public for a fire similar to the single unit "Portcullis" screen model, which has proved very popular during the past two years, Messrs. Bratt Colbran & Co., of 10, Mortimer Street, W. 1, have brought out a two-unit model.



This fire, which is illustrated in the accompanying photograph, is light and easy to carry, and it can be moved without difficulty from room to room. Either one or both radiant units may be lighted as desired, thus enabling the fire to be used for rapidly promoting comfortable conditions in a room and then turned down to maintain an equable temperature.

The gas consumption is 10 c.ft. per hour with one unit alight and 20 c.ft. with both units lighted. It will therefore be appreciated that when both burners are alight it is essential that the fire be only used in close proximity to a flue. The dimensions are 24½ in. high, 17½ in. wide, and 10½ in. deep, while the fire is available in rustless steel, bronze, and lustral colour finishes.

BOOK REVIEWS

The Law Relating to Gas and Water.

Volume II.—Water.*

Since the last edition of the Water Volume of this work was published a considerable amount of fresh legislation dealing with water has been passed. The introduction deals fully with the recent legislation, both public and private, and has been somewhat rearranged so as to make reference to the different matters dealt with in it more easy. It has been decided to include in this edition the Companies Clauses Acts which were formerly included in this work, and also the text of the Land Clauses Acts. The present edition can therefore be said to contain all the Acts to which reference is likely to be made by those dealing with the law relating to water.

Recent legislation dealing with gas has delayed the publication of Volume I. of Michael and Will, and is the reason for Volume II. being published first.

* Michael and Will on the Law Relating to Gas and Water, 8th Edition, by the late F. T. Villiers Bayley and H. I. Willis. Butterworth & Co. (Publishers), Ltd., Bell Yard, Temple Bar, W.C. 2; price, £3 3s. net.

Gas and Water Engineers' Calendar, 1935.*

We have once more to welcome a new edition of this well-known year-book. As usual, a section is devoted to a list of the gas-works of twenty Continental countries with particulars of their annual make, ownership, and chief officials. Particulars of a wide range of plant and appliances employed in the Gas Industry are to be found in a section devoted to the trade announcements of well-known German firms.

We find numerous occasions to consult the book during the course of a year, and we have no doubt that this is also the case with those of our readers who have business relations with the Continent either as purchasers or sellers.

* Kalender für das Gas- und Wasserfach, 58th Edition, 1935. Part I. [Munich and Berlin, R. Oldenbourg. Pp. 398. Price R.M. 5, bound.]

UNDER THE LENS

By Quidnunc

This Woman Business

Brass Tacks about Women's Associations.

"What Halifax thinks to-day, London thinks to-morrow." This revised proverb expresses the changed views of the Gas Industry towards women's societies. A year ago most gas managers turned a cold and lacklustre eye on the activities of the Electrical Association for Women. A year ago Mr. W. B. McLusky started the Halifax branch of the Women's Gas Development Association. A second branch has been launched at Harrogate, and others are under consideration in several Yorkshire towns. Now the movement has reached London, and schemes for a national federation of gas-minded women are in the air. The constitution-mongers, muttering "Cherchez la femme," are hard at work; anyone can attract women, on paper. There is little doubt that members of the Industry will shortly be asked to form Women's Gas Associations in their own districts. This means that the individual gas manager will be responsible for the success or failure of his local branch. Therefore, before magnificent constitutions and imposing programmes are drafted, we should take careful stock of all this woman business. Far better not to start a Women's Association at all, than to see it perish in the dank atmosphere of showroom tea-parties.

"Boosters, Not Knockers."

Is a Women's Gas Association really worth while? Mr. McLusky, of Halifax, and Mr. Bateman, of Harrogate, the only members of the Industry with first-hand experience, have answered with an emphatic Yes, though it is impossible to estimate the value of their Associations in terms of hard cash. It is best to put the question in another way. Is it worth while to have the most active women in your community interested in the Gas Industry and its work—to make them "boosters, not knockers," in the Yankee idiom? Is it worth while to secure the confidence and the willing co-operation of a representative cross-section of your women consumers, and to convert them into unprejudiced and unpaid salesmen, operating an amateur Whispering Campaign on behalf of gas? If so, it is worth while to have a Women's Gas Association, provided you are willing to lavish time and care on its organization and running. We may profitably examine the methods of existing associations to see whether there are any hints to be picked up.

Miss Haslett's Girls.

What can we learn from the E.A.W., the first in the field? In the positive sense, not much. The E.A.W., after ten years of the struggle for existence, has 50 branches with about 7,000 members all told. Its history is largely the personal epic of Miss Caroline Haslett, a first-rate organizer who thrives on difficulties. The personnel of the various branches will repay a little curious study. It would seem that many of the founder-members are the wives or relatives of electrical men. It is quite impossible to guess how many of the 7,000 are genuine zealots in the cause of electricity. What are the inducements to join? There is a members' magazine, the *Electrical Age;* there is a social side which may be expected to appeal to idle women in a torpid town where amusement is largely home-made; there is a vague idea, sedulously inculcated, that by becoming a member a woman has enrolled herself in the forces of Progress, the ultimate aim of which, under providence, is to install an electric cooker in every slum kitchen.

Now there can be no reasonable doubt that any efficient gas manager who looks after his women consumers could easily gather the nucleus of a district Association far more powerful than any branch of the E.A.W. It is admitted in general by the electricians that their demonstrators and saleswomen are not up to the Gas Industry's standard; and in running a women's society successfully, it is essential to have a professional background of trained women. The Gas Industry scores there, as Mrs. Eileen Murphy recently demonstrated in her Sheffield speech on Home Service.

How to Choose Members.

Mrs. Murphy, I may say, is a member of the Halifax G.D.A., and so proud of it that she wears the badge in her lapel at all public meetings. She regards her own branch as a worthy model, and gave me the following account of its formation:

> *The G.D.A. started among a few ladies who are active in the public life of the town. Each of these ladies invited a number of personal friends and acquaintances to the General Meeting at which the Association was launched. The resultant gathering was completely representative of the community, without distinction of class, age, or calling. The members now include elderly ladies of rich experience, young mothers, business women, keen politicians, social and church workers, civil servants, sportswomen, and others. In fact, the only characteristics common to all members are intelligence, activity, and public spirit. Mr. McLusky tells me, "We have never considered whether a person invited to become a member used gas or not." But I suppose all the members do use gas; in any case, if you want to see genuine interest and unforced enthusiasm about gas among members of the public, I recommend a visit to the Halifax G.D.A.*

An Association constituted on these lines puts the Gas Industry in its proper focus as a public service deserving public interest. Its members, instead of regarding their own undertaking as a soulless machine, begin to feel that they have a voice in its direction and a personal pride in its achievements. At a recent meeting of the Harrogate G.D.A. the members, instead of inviting a set speaker, held an open debate which produced a number of helpful suggestions and constructive criticisms. It is a healthy state of affairs when consumers take an energetic interest in the welfare of their own undertaking; and this is the natural outcome of a well-run women's association. It forms a personal tie between staff and consumers, and when it is remembered that every member in her own way is an active and influential woman with many interests and a wide circle of acquaintance, the advantages of such an association become obvious.

The Functions of G.D.A.

As I understand it, Mrs. Murphy recommends that members should be given a free hand in the election of officers and management of meetings, and that where possible the honorary officials should be made free of the gas offices for clerical work, &c. Meetings should be held at least once a month; they may be to hear an address from a well-known speaker, to visit a works or factory using gas, or to debate on questions in which the Gas Industry is vitally interested, such as housing and slum clearance, or smoke abatement. Representatives of the local papers will find valuable "copy" in all these functions. The Association is also an effective link between the various Home Service activities, because members will often give suggestions for certain dishes which they would like to see cooked at the regular demonstrations, or ask for special talks or displays. They should be encouraged to take a real interest in every side of the undertaking's activities.

Federation? Why?

It will be seen that a good deal of thought and care is necessary behind the scenes if the Association is to be thoroughly well run. The final responsibility must always be the manager's. Not that the Association need be purely local in outlook. The Halifax G.D.A. has already done valuable missionary work in other parts of Yorkshire. As more undertakings follow the example of the pioneers, a co-operative Federation of women's gas associations will become possible. Such a Federation, having a national standing, would naturally be consulted by outside official bodies on many important points as being the mouthpiece of all the domestic consumers of gas. It would be a woman's Parliament expressing the consumer's viewpoint, but fully appreciative of the real interests and importance of the Industry. In addition, the Federation would be able to secure well-known speakers, circulate news, ideas, and literature among the various branches, and keep the activities of the Gas Association well in the public eye.

With a large number of branches, a Federation need cost very little to the individual undertaking. It will certainly be lucky if it has a call on the services of Mrs. Murphy, a picturesque figure as well known outside the Gas Industry as inside it, who combines resourcefulness, originality, and fluency with remarkable energy and crispness of style. Suspicious as I am of all women's activities, her enthusiasm has goaded me to devote this first article to women. Next time I shall write on topics of more inherent interest.

Refractories Research

The Mellor Laboratories, Stoke-on-Trent.

There was a "private view" in connection with the "christening" of the new laboratories on Wednesday, Dec. 5, attended by many prominent in the research, manufacture, and usage of refractory materials, including Mr. C. Valon Bennett, President of the Institution of Gas Engineers, and Mr. F. P. Tarratt, Immediate Past-President.

In the Report of the Refractory Materials Joint Sub-Committee of the Institution of Gas Engineers, the Society of British Gas Industries, and the British Refractories Research Association, presented at the Autumn Research Meeting of the Institution, it was mentioned that the Headquarters of the B.R.R.A. had been moved from the North Staffordshire Technical College at Stoke-on-Trent, to newer and larger laboratories most fittingly named the Mellor Laboratories. The "formal christening" took place last Wednesday, and the first "private view" provided an opportunity of seeing how efficiently an increasing volume of refractories research is being carried out at Stoke-on-Trent. Perhaps our description of the New Laboratories will encourage members of the Institution and others interested to inspect the premises. They are assured of a warm welcome, and they will certainly not be disappointed with the visit.

The Mellor Laboratories represent the first independent institution to be devoted solely to research and cognate matters in the clay industries, and their inception owes a great deal to the Gas Industry. The first glimmer of the idea for refractories research dates from conversations between Lieut.-Colonel C. W. Thomas and Dr. J. W. Mellor, culminating in a conference at the North Stafford Hotel on Jan. 4, 1909. The meeting was attended by representatives of the Institution of Gas Engineers, manufacturers of refractories, and a few prominent men in some other industries. The idea of organized research in the refractories industries was considered to be startling and novel, but it was sympathetically received even by the sceptics.

The subject was taken up by Mr. F. J. Bywater, of the South Metropolitan Gas Company, who was largely instrumental in founding the Refractory Materials Committee of the Institution of Gas Engineeers. The work of that Committee proceeded unostentatiously and quietly, without the beating of the big drum or the fanfare of trumpets. The first year's grant towards the expense of the Committee was nominal; but, as the importance of the work was gradually recognized, the Committee received larger and larger grants. One result of that work in the Gas Industry has been to increase the life of refractories, and this in spite of a simultaneous increase in the temperatures of carbonizaton, so that estimates of the savings which have been effected in the manufacture of gas are quite sensational.

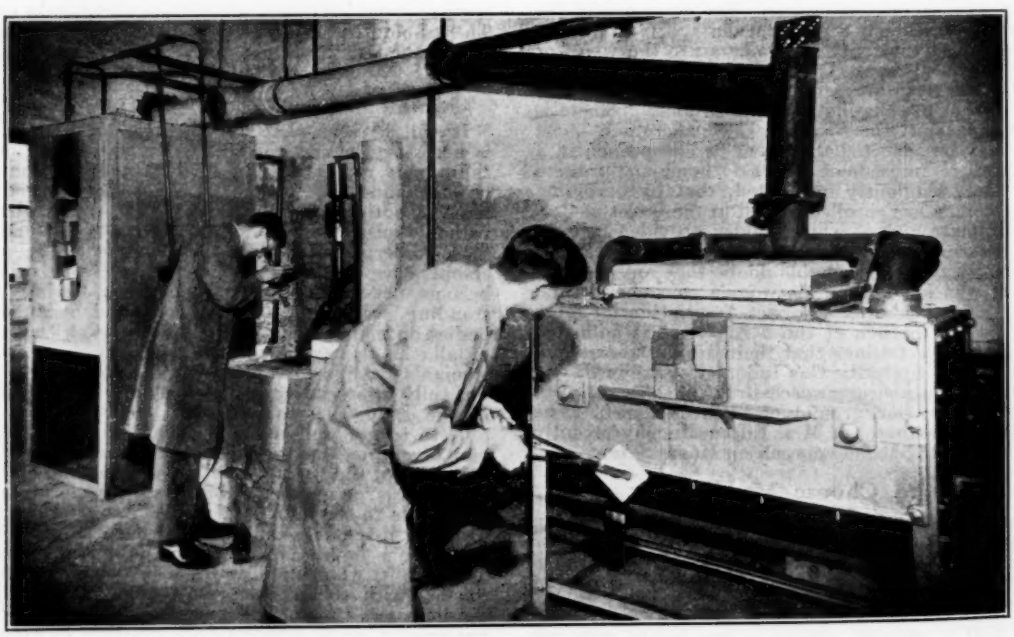
Our general ignorance of refractories was emphasized during the war, and still further when the Faraday Society had a symposium on Refractory Materials in 1917; the Department of Scientific and Industrial Research was founded a little before that time. Refractories were in the air, so to speak, but they were brought to *terra firma* by the founding of the British Refractories Research Association on April 14, 1920, as one of the associations nurtured by the Department of Scientific and Industrial Research. The Association has had its ups-and-downs, but at no time in its existence have the auspices been so favourable or its prospects so bright as they are at the present time.

Colonel Thomas has been Chairman of the Association from its inception, and he has been ably supported by the Vice-Chairman, Mr. Frank West.

The valuable and enthusiastic work of Mr. A. T. Green, Assistant Director, is well known to the Gas Industry.

The name of the Mellor Laboratories was intended by the Council as a grateful recognition of Dr. Mellor's long and distinguished services to the Ceramic Industries in general.

In the early days, virtually all the serious testing for British refractories was done in Germany. Dr. Mellor, in a modest, virtually private, way, commenced testing refractories in the County Pottery Laboratory at Tunstall. The work grew, and grew, until finally it has necessitated the formation of a special testing department of the B.R.R.A. This has largely been brought about because the staff of the B.R.R.A. has been responsible for the work in connection with Specifications drawn up in recent years

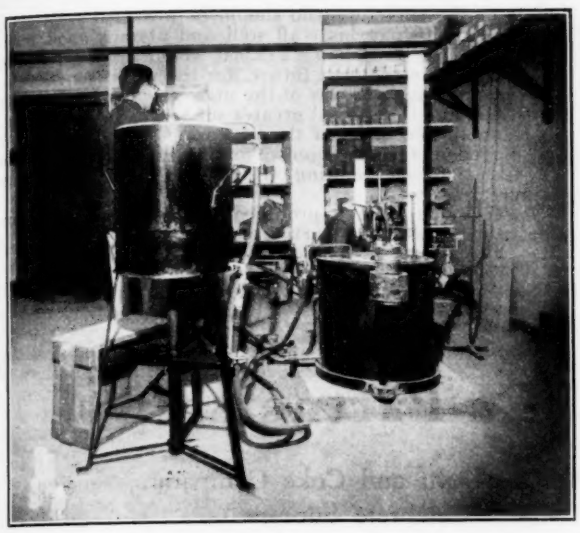


SOME OF THE GAS FURNACES IN THE MELLOR LABORATORIES.

by the various Joint Committees, and the experience gained in carrying out this work has therefore been unique.

The New Laboratories.

The building was originally a private residence, but at a later period it had been used as a private school. There are twelve rooms of normal size, eight of which are fitted up as laboratories. Two of the front rooms on the ground floor are the Office, and the Board Room and Director's Office. The rooms immediately above these on the first



Furnaces and Equipment employed for testing refractories under load.

floor are the Office of the Assistant Director, and a Staff Common Room.

The large room on the ground floor, measuring 30 by 20 ft., is now the "Big Lab." In this laboratory a large Avery Universal Testing Machine has been accommodated. This machine is one of the latest models, and can be used either as a 20 or a 50 ton capacity machine. It was originally designed for testing steel and other metals, but it is, of course, readily applicable to the testing of refractory and similar materials. It is fitted with an autographic recorder and a load maintenance device. In the determination of the crushing strength of samples, the rate at which the load is applied can be varied from ½ to 10 tons per minute, and can be controlled within narrow limits.

The machine has been slightly modified, so that the transverse strength of bars of refractory material with a minimum cross section of 2 in. square and a span of 7 in. can be accurately determined with it. The transverse strength of full-sized bricks can also be readily determined on the 9 by 4 in. face. It is hoped that facilities will also be available soon for carrying out cold tensile strength tests.

This machine, which evoked much admiration, is undoubtedly one of the finest available for crushing and transverse strength tests, and it will add immensely to the value of the services rendered by the Association to the Gas Industry. Furthermore, investigations are in progress to extend the usefulness of the machine by suitable modifications, in order to determine the moduli of elasticity, using an extensometer to measure changes in shape which test-pieces may undergo while being subjected to a given stress.

This laboratory also houses an Impact Testing Machine, which again has been modified for use with refractory materials. Impact is given by a pendulum, and can be varied by means of a suitable adjustment.

Apparatus for measuring the transverse strength of suitable sized specimens (1 by 1 by 9 in.), both at room temperatures and up to 1,000°, the modulus of elasticity up to 1,000°, and pyroplastic deformation is also accommodated in this room. Here also are carried out the thermal expansion tests on refractory materials up to 1,000°. Mention must also be made of the automatic hammer machine, by means of which refractory materials can be subjected to a large number of small mechanical shocks. The hammer falls on to the test-piece from a definite height and at a definite rate of striking, and the number of blows required to cause failure is recorded.

At one end of this room an experimental dryer is installed. This is capable of drying clay blocks and shapes up to about 18 by 18 by 18 in. in size and 1 cwt. in weight, under accurately controlled conditions of temperature and humidity for indefinite periods. Automatic weighing mechanism records the rate of drying. A number of investigations have already been completed with this apparatus.

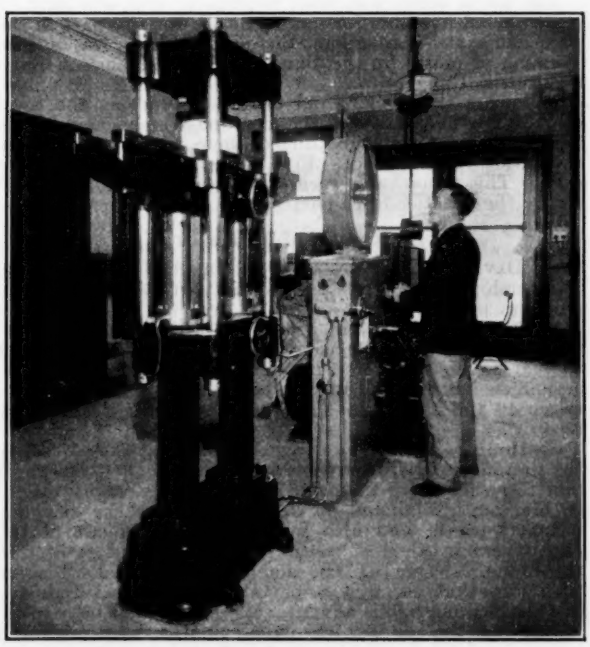
Adjacent the big laboratory on the ground floor are two smaller rooms in which the electric furnaces for determining the refractoriness and refractoriness-under-load of refractory materials have been installed. Here, too, the research work on jointing and patching cements is being continued.

On the first floor five rooms are equipped as laboratories, including a chemical laboratory and balance room. In the chemical laboratory, in addition to the usual apparatus for carrying out chemical tests and analyses, there has been fitted up special apparatus for studying the effect of carbon monoxide on refractory materials at (*a*) different temperatures, and (*b*) different rates of flow and concentrations of gas. In another room, of rather larger dimensions, the work on the effect of alkalis on refractory materials at high temperatures is being continued, together with experiments on the texture of non-plastic mixtures such as silica and sillimanite. In connection with the latter, the apparatus for measuring the permeability of refractories is brought into use.

The subject of microscopic examination of refractory materials forms an important part of the programme of work. One of the rooms was found to be eminently suitable for the installation of the necessary apparatus, and it has been converted at small expense into an admirable dark-room. Thin sections of material and also powders are here prepared for microscopic examination with an instrument which has been specially designed to carry out modern petrological investigations. The microscopic observations are recorded by means of photo-micrographic apparatus. Both macroscopic and microscopic examination of refractory materials can also be carried out by incidental light. At present the micrographic study of slag attack is proceeding.

In a fourth room apparatus has been installed to study the flow of water through plastic clay.

An important consideration, which no doubt greatly influenced the Council in their final decision, is the fact that the extensive grounds to the property afford ample facility for future extensions to the buildings. Furthermore, there are already a number of outbuildings, and these are being used to accommodate the gas furnaces and air-blower, while one has been fitted up as a grinding shop and tool shed. The gas furnaces deserve some mention. One is a large-



The Universal Testing Machine.

size Fletcher-Russell furnace capable of holding a number of full-sized bricks and firing to 1,100°. The Brayshaw furnace can safely be worked up to temperatures of about 1,500°. A third furnace has been built with the object of studying slag erosion. In this furnace powdered slag can be fed in along with the air blast and made to impinge at an angle of 45° on the hot test-piece, which is in a vertical position. There is still another furnace, which has been specially designed to investigate slag attack—and also for

general purposes—at temperatures above 1,600°. This has a double chamber, the products of combustion from the hot chamber heating up the second chamber to about 1,200°. The whole of this furnace, except the top, is insulated with 4½-in. insulating bricks.

There can be no doubt that the transfer of that part of the Association's activities which deals solely with research work and the testing of materials will be reflected in a still further extension of the useful services which have already been rendered to the Industry.

At a luncheon in the North Staffordshire Hotel to celebrate the christening of the new Laboratories the Chair was taken by Colonel Thomas, and among those at the top table were Sir Kenneth Lee, LL.D. (Advisory Council, Department of Scientific and Industrial Research), Mr. Frank West, Mr. C. Valon Bennett (President of the Institution of Gas Engineers) and Mr. F. P. Tarratt (immediate Past-President of the Institution), and Dr. Mellor.

Colonel Thomas, on behalf of the Council of the B.R.R.A., proposed the toast of "Our Guests." He outlined the development of the work leading up to the Mellor Laboratories, and paid tribute to the Gas Industry's enthusiastic support. He also expressed indebtedness to the Department of Scientific and Industrial Research, whose practical advice and encouragement were so keenly appreciated. It was, he said, of the utmost importance that the value of research on refractories should be fully realized.

Sir Kenneth Lee, who responded, said that the Department of Scientific and Industrial Research had come to the conclusion, after sixteen years, that an income of £10,000 to £12,000 was a minimum for an independent research association. It was a great mistake to carry on research unless it was done thoroughly. Under such a sum it was unfair to the Director, who should be provided with sufficient money to pay his staff well and attract good men. He hoped that £10,000 to £12,000 would be the basis of the B.R.R.A. in the near future, for the work the Association was carrying out was of the utmost value to the older industries, and it deserved greater support. In concluding, Sir Kenneth Lee spoke of the part which Mr. Frank West had played in the development of the Association, and of Mr. Green as one working in the real interests of long-distance research.

Mr. C. Valon Bennett proposed the health of the Chairman, which toast was heartily accorded.

Twenty-Five Years of Co-Partnership

17,000 Co-Partners in the Gas Light and Coke Company hold £1,000,000 of the Company's stock—one of the facts mentioned by Sir David Milne-Watson at a Co-Partnership Dinner last Thursday in London.

The Gas Light and Coke Company Celebrate Success

On Thursday last the Gas Light and Coke Company celebrated twenty-five years of Co-Partnership by a dinner in the New Horticultural Hall, London. About 900 co-partners were present. In the chair was Sir David Milne-Watson, LL.D., D.L., Governor of the Company, and the guest of honour was the Rt. Hon. Viscount Cecil of Chelwood, K.C., D.C.L., LL.D.

The whole scene was most impressive and will long be remembered by those fortunate enough to take part in the proceedings. Throughout the dinner there was a programme of music by the Band of The 12th London Regiment (The Rangers).

Following the dinner, and prior to proposing the toast of "Co-Partnership," Sir David Milne-Watson made Long Service Presentations to thirteen men who have between them 640½ years' service. Five of them have over 50 years each. This remarkable record must in part be accounted for by the practice of co-partnership principles.

A Remarkable Record.

Sir David Milne-Watson, proposing the toast of "Co-Partnership," said that besides the vast gathering of co-partners present that evening, there were no fewer than 154 long-service men and pensioners whose aggregate service amounted to 6,600 years, with an average service of 43 years. Seven of the pensioners had served for 50 years, seventeen between 45 and 50 years, and thirty-seven between 40 and 45 years. This surely was an extraordinary record.

Continuing, Sir David said how honoured they were by the presence of Lord Cecil as their guest. They welcomed him there for more than one reason. They were grateful to him for his labours at Geneva in the cause of international peace, and also for his encouragement of the co-partnership ideal of mutual confidence and respect in the industrial sphere. He thought they would all agree with him that through co-partnership the Gas Industry had derived enormous advantage, and it would be a splendid day for the country when the co-partnership spirit and system was universally adopted in British industry.

When the Co-Partnership Scheme of the Gas Light and Coke Company was started in 1909, Sir Corbet Woodall and himself never doubted that it would confer great benefit upon its members and upon the Company. He regretted that Mr. Henry Woodall, who was Deputy Chairman of the Co-Partnership Committee, could not be there that night to honour the memory of his father.

[Mr. Henry Woodall had sent a letter of regret to Sir David, which he read.]

The Co-Partnership Scheme commenced, said Sir David, with a distribution of £38,000 by the Directors as a nest-egg bonus to 8,500 co-partners, and they would be interested to know that about 4,000 of the original co-partners of 1909 were still with the Company. He was proud to say that to-day there were 17,000 co-partners holding in various amounts £1,000,000 of the Company's Ordinary Stock and having a total interest in the Company exceeding £1,500,000 in value. About 900 co-partners were present that evening, but they represented only one twenty-fifth of the total membership. But he would remind them of the slogan: "Mr. Therm never lets London down," and that if all were present—though in fact no hall in London could accommodate them—there would be no gas for London.

The spirit of the Co-partnership Scheme had permeated the whole of the Company's organization so that now they had not only their Co-Partnership Committee and Co-Partners' Non-Staff Pension Fund, but their Works Committees, Sports Association and Awards Committee, Sick Benefit Schemes, and their War Memorial Fund. This in itself was a signal success, but it was not all. There was no doubt that the money value of co-partnership was very great. It gave many of the men something to look forward to in old age and thus enabled them to face the problems of retirement with a lighter heart. Even though their pension scheme was working splendidly and was making excellent provision for old age and retirement, the fact that each co-partner had a nest-egg as well made an enormous difference.

This was a red letter day in the history of the Company, concluded Sir David. They had examined the position of the non-staff pension fund and had found it in a prosperous condition, and the Directors had decided to increase the full pension by one-eighth. [Cheers.]

Competition and Co-Operation.

Lord Cecil of Chelwood said he had listened with the utmost interest and admiration to Sir David's account of the success of co-partnership in the Gas Light and Coke Company. He spoke as one outside the scheme, but he had had one moment of comfort in listening to the presentations. One of the presentations was to a piece-worker in the purification department—surely an ideal employment. He himself had little claim to purification, but he liked to be regarded as a peace worker. And to attain peace they must preach and establish the principles of co-partnership among the nations of the world. He had, however, a better claim than that to respond to the toast. As a young man he practised in the Committee Rooms of the House of Commons and frequently had the good fortune to be employed by the South Metropolitan Gas Company, whose President at the time was Sir George Livesey, one of the most remarkable men he had ever met. On occasion he

had heard one of the greatest exponents of co-partnership explain what it meant; and the more he heard the more convinced he became that if only the industries of the country were carried out on the basis of co-partnership, everybody would be happier and there would be an end to the greater part of their industrial troubles. If he remembered aright, Sir George Livesey described co-partnership as a step towards the democratization of industry—in which he, Lord Cecil, was as profound a believer as ever. In any company of human beings working together they found two great principles which made work valuable and effective. They were competition and co-operation. Both individual and co-operative effort were essential, and this was the central doctrine of co-partnership.

The remaining toast was "The Company," proposed by Mr. B. R. BARBER, formerly Pier Foreman at Beckton, and with a service record of 51¾ years, and seconded by Mr. F. J. CORNE, Co-Partner Workman Trustee. Sir DAVID MILNE-WATSON acknowledged the toast.

Private Bills to be Introduced in 1934-35

A *Precis* of the Clauses affecting gas interests.

South Metropolitan.

"To extend the limits of supply of the South Metropolitan Gas Company . . .," &c. This Bill has been necessitated by the fact that what used to be the Parish of Mottingham has now been incorporated in the district of Chislehurst and Sidcup, and has therefore become technically outside the limits of supply of the Company.

The Bill proposes therefore to extend the limits of the Company so as to cover the point. At the same time, the Company seek power in the Bill to ascertain the number of therms supplied either—

(1) by multiplying the number of cubic feet of gas registered on the meter by the number of B.Th.U. comprised in the calorific value and dividing by 100,000;
or
(2) by incorporating a train of two wheels in the cubic foot index dial of the meter so that the volume of gas passing through the meter can be registered in therms.

The Company also seek powers in the event of their altering the calorific value of their gas to alter, adjust, or replace consumers' burners at their own expense to secure efficiency and safety.

Powers are also sought to appoint an additional Director and to provide the Employees' Directors shall be additional to ordinary Directors.

[*Agents: Sherwood & Co.*]

Halifax.

"To extend the boundaries of the County Borough of Halifax . . .," &c. In Clause 19 powers are taken to extend the Corporation gas supply limits to the areas covered by the extension of the boundaries. It is provided that the Corporation may continue the existing gas-works of the Sowerby Council and of the Hipperholme Council, and may make and manufacture gas and residual products on the lands thereof.

[*Agents: Lewin, Gregory, Torr, Durnford, & Co.*]

South Suburban.

"To confer further powers upon the South Suburban Gas Company . . .," &c. The Bill re-defines the limits of supply following the revision of boundaries in Kent. The Bill further seeks to empower the Company to raise additional capital not exceeding £500,000.

The Bill then re-defines the differential price areas, states that the charge for street lighting shall never be more than the lowest rate charged to domestic consumers in the same area, and makes certain minor alterations in the administrative provisions dealing with meetings, shares, &c. The Bill also seeks powers to enable the Company to construct new gas and storage works on land near Sevenoaks, Tonbridge, and Crayford, and to provide a recreation ground for the employees.

Clause 23 relieves the Company from the obligation, subject to arbitration, to supply gas in certain circumstances, and a further clause states that "not later than 1942 the Company shall promote a further Bill in Parliament proposing a revision of the basic price fixed by the Act of 1928, and that any County Council, Borough Council, or Urban District Council within the limits of supply shall be heard."

[*Agents: Sherwood & Co.*]

Stoke-on-Trent.

In Clause 22 of this Bill power is sought for the Corporation to supply gas to houses partly within and partly without the gas limits, provided they shall not infringe the supply limits of other gas undertakings without their consent.

In Clause 25 the Corporation seek powers, if they think fit, to make a specification with regard to the minimum size and material of the pipes to be laid by the owner or occupier of any premises either in the first instance or on the occasion of any renewal. These specifications must be approved by the Board of Trade, who in turn must refer the matter to an independent gas engineer, and if they think fit, direct and hold a Public Inquiry.

[*Agents: Lewin, Gregory, Torr, Durnford, & Co.*]

Metropolitan Water Board.

"To empower the Board to execute works . . .," &c.

In Clause 15 provision is made for the protection of gas, water, and electricity companies' mains and sewers.

[*Agents: Dyson Bell & Co.*]

Bognor.

"To consolidate with amendments the provisions of the Bognor Gas and Electricity Acts and Orders, 1908 to 1927, relating to the capital and borrowing powers of the Bognor Gas and Electricity Company; to authorize the Company to raise additional money; to confer further powers upon the Company; and for other purposes."

Clause 7 provides that the capital of the Gas and Electricity Company shall be £388,070. Additional capital not exceeding £200,000 may be raised as necessary. Clause 13 provides that up to one-fourth of any new share capital issued may be reserved exclusively in the first instance for consumers of gas and electricity and employees.

Dividends on consolidated ordinary A and B stock shall not exceed 5%, and on new consolidated stock shall not exceed 7%. Dividends on preference shares must not exceed 6%. The dividends on the consolidated ordinary stocks are to be dependent on the price of gas.

In Clause 47 power is taken to purchase additional lands, and in Clause 48 to provide a recreation ground for employees. The usual powers for entry and inspection are also provided for.

[*Agents: Dyson Bell & Co.*]

Ascot.

"To convert the existing capital of the Ascot District Gas and Electricity Company; to authorize the raising of additional capital; and for other purposes."

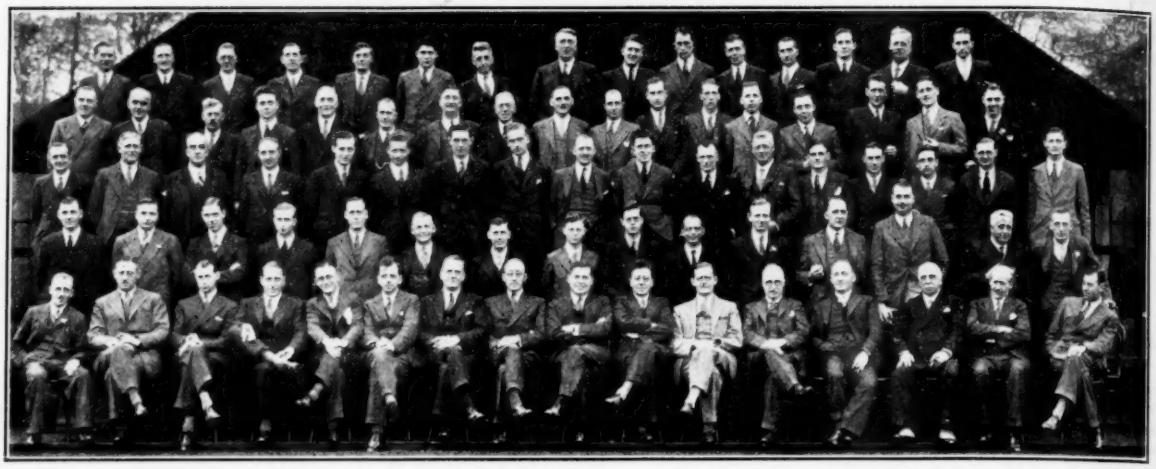
The Bill provides for the consolidation of the capital into ordinary and preference stock. Clause 11 provides that additional capital may be raised by the issue of stock from time to time of £100,000. Extra borrowing powers are also sought.

The basic price of gas is to be 12·8d. per therm. Powers are taken to revise this at any time after three years, subject to certain arrangements. Dividends are to be limited to 5% on the ordinary stock and 6% on the preference stock. Profits are to be divided with a view to interesting the employees and consumers in the efficient working of the undertaking, and Clause 28 accordingly makes provision for an elaborate division to this end.

[*Agents: Lees & Co.*]

London and Southern District Juniors

Visit to the Wellington Tube Works



A GROUP TAKEN AT THE WELLINGTON TUBE WORKS.

On Wednesday, Dec. 5, nearly sixty members of the London and Southern District Junior Gas Association left London to visit the Wellington Tube Works. At Birmingham the party was met by coach and conveyed to Messrs. Johnson's Iron Works, where by the courtesy of the Directors the manufacture of puddled wrought iron was witnessed. This visit was arranged by the Wellington Tube Company, since it was considered that the Association should see this process before inspecting the manufacture of iron and steel tubes.

An hour having been spent at Messrs. Johnson's works, the members left for the Wellington Tube Works, where lunch was taken in the main offices by courtesy of the Company's Directors. The toast of "The Wellington Tube Works" was proposed by Mr. F. C. Smith, President of the Association. Mr. Douglas W. Turner, Chairman of the Company, welcomed the Juniors because he believed in customers seeing the works, and added that co-operation with London was very essential to that area. He personally had a close association with the Gas Industry since he had the honour of being Chairman of the Society of British Gas Industries.

After lunch a tour of the works began, and an interesting afternoon was spent in witnessing the manufacture of tubes, bends, tees, &c. The party then returned to the main offices, where tea was taken. On behalf of the Association, Mr. Smith thanked Mr. Turner and the Wellington Tube Company for a both interesting and instructive day. He said that he had been thrilled by what he had seen, and went on to refer to the stringent tests that his Company applied to the tubes that they had to use. Mr. J. W. Webber, Senior Vice-President of the Association, endorsed the President's thanks. Mr. R. G. Marsh, of the Birmingham Gas Department, then briefly outlined some of the difficulties which attended the installation of the new Class A lighting in New Street and Corporation Street. The route from Tipton back to Birmingham included New Street, and the Association had an opportunity of seeing the excellent result of this work.

Low-Temperature Carbonization.

The "Coalite" Process.

At a meeting of the Chemical Engineering Group of the Society of Chemical Industry in London on Friday, Nov. 23, Colonel W. A. Bristow read a paper on the chemical engineering aspect of low-temperature carbonization, in which he gave a brief account of the now well-known history of low-temperature carbonization and a description of the plants which have been erected by his Company, Low-Temperature Carbonisation, Ltd., at Barugh and Askern, and also at the works of the South Metropolitan Gas Company at Greenwich. The first was erected in 1927, the second in 1929, and has been considerably added to since, while the plant at Greenwich was erected in 1931. In these three works there are a total of 628 retorts with a capacity for dealing with 370,000 tons of coal per annum. These works are in continuous operation day and night, and every detail is so arranged that ordinary cleaning operations and such minor repairs as are necessary can be conducted without interfering with the production. The total amount of coal carbonized since the end of 1927 at the three works now amounts to nearly 1,500,000 tons, and, in addition to the one million tons of smokeless fuel produced, there has been made, fractionated, distilled, refined, and distributed 150,000 tons of coal oil and coal petrol. In addition to the three works now operating, two more are to be built immediately, thus raising the throughput capacity to approximately 2,000 tons per day. No difficulty whatever is anticipated in the disposal of the extra output as the demand is always in excess of the supply, and the need for home-produced petrol and fuel oil has now become a national question of the first magnitude.

Mr. P. Parrish (South Metropolitan Gas Company), in the discussion, said he substantially agreed with what the author had said in the paper. At the same time when the South Metropolitan Gas Company installed its low-temperature carbonization plant it did so with certain misgivings as to the life of the retorts, but he could say without hesitation that they had been agreeably surprised with the quality of the retort with which they had been supplied. Although the plant had been working for two or three years there was no sign yet of the retorts giving out. That was not entirely due to Colonel Bristow and his Company, but it was in large part. There were one or two factors which affected the longevity of a retort in the low-temperature carbonization process. One was the correct design of the retort, another was the right alloy, and another of almost equal importance was the question of the correct operation of the retorts. The South Metropolitan Gas Company had demonstrated more than any other company how with careful chemical and physical control in the operations the life of the retort could be added to very materially. Undoubtedly the type of retort that had now been evolved had many special features, one of which was that it brought about almost automatic sizing of the fuel, and, therefore, dispensed with a great deal of labour from the point of view of screening.

Colonel Bristow, in the course of his reply to the discussion, said that five years ago he would never have anticipated such a testimonial from Mr. Parrish. So far as the position of the smokeless fuel industry and the Gas Industry was concerned he did not pretend to know why there had not been closer co-operation between the two industries, but in his view the manufacture of smokeless fuel by low-temperature carbonization was a self-contained industry, and was not necessarily dependent on assistance from the present Gas Industry. At the same time he strongly held the view that there were many circumstances in which co-operation between the Gas Industry and low-temperature carbonization, by putting down small low-temperature plants according to requirements, would help.

THIS ENAMEL AGE

SO important to the Gas Industry is the part played by enamel in the world of to-day that this insight into the enameller's own problems will interest many readers.

A Paper read before the Institute of Vitreous Enamellers.

By **N. H. OAKLEY-EVANS,** Sales Manager of Armco, Ltd.

Enamelling Iron.

An introduction tracing the development, from earliest days, of man's application of iron to his own purposes, and the various processes for producing it in suitable form, led the author to the point where, following years of research by the United States Government, the American Rolling Mill Company endeavoured to produce in the basic open hearth furnace a pure iron comparable to the old wrought iron of the past, but free from the slag inclusions which are common to that type of metal. After several years of extremely costly experimentation, pure iron from the open hearth was evolved, and a realm of new applications soon followed in the wake of the newly developed product. Although created primarily to cope with the problem of corrosion, pure iron was soon recognized as an ideal base metal for the exacting requirements of the enamelling industry.

The problems and needs of the enameller were studied with meticulous care, and eventually a special grade of material was evolved to satisfy the enamellers' demands, which can be briefly summarized as follows:

(1) Cleanliness of structure and surface.
(2) Freedom from distortion.
(3) A surface suitable for a tight bond with the enamel.
(4) Uniformity and consistency in quality.
(5) Accuracy in gauge, size, and flatness.
(6) Reliable welding properties.
(7) Deep drawing qualities.

In short, a sheet which would enable the enameller to create a finished product of beauty and utility at reasonable costs.

A clean enamelling shop is a pre-requisite to good enamelling, and likewise clean ingredients are essential in the materials which are utilized in most successful enamelling.

Cleanliness.

Cleanliness in metal is imperative. Structurally it must be sound and pure. Raw materials are selected with care and to specific analyses. The refining process in the open hearth furnace must be prolonged at high temperatures, with frequent check tests, to obtain metal of the necessary purity and uniformly free from harmful inclusions. A uniform ferrite structure is desirable, virtually without iron carbides which are common to steel. It is essential for best results that a sound structure be accompanied by uniformly clean sheet surface, to avoid pitfalls in enamelling. Good surface is not only the result of sheet rolling, but is dependent upon exacting care being exercised throughout processing, from the ingot to the final operation on the sheets.

Heating of ingots in the soaking pits prior to blooming and bar rolling should be done so that a uniform temperature is attained without burning or overheating the iron. Conditions of blooming and bar mills must be such that heavy scale, scabs, lapped bars, and rough edges are eliminated. The slabs must be carefully cropped to avoid lamination which might occur from piped areas. At the hot mills, where the bars are reduced to sheets, heating again is a serious problem. Grease, heavy scaling, and inaccurate gauge are a few of the worries of the hot mill man. Contrasted with commodity mill floors, hot mill standings, where pure iron is made, must be immaculate; temperatures have to be carefully regulated and atmospheres clean and under strict control; otherwise prime quality cannot be obtained.

Cleanliness must again be exercised in heat treating whether sheets are box annealed or normalized, temperatures pyrometrically controlled, and the fuel and furnace conditions such that proper reducing atmospheres obtain. Pickling operations demand constant checks on temperatures, acid concentration and freedom from foreign matter which might be detrimental to sheet surfaces. Throughout the processing of enamelling metal, great care is exercised in all handling, rolling, and shearing to avoid surface contamination by oil, grease, or any extraneous matter.

Thus in the steel mill, as well as in the enamelling shop, the cardinal principle in obtaining a sound reliable product is cleanliness.

Freedom from Distortion.

Freedom from distortion or sagging is a characteristic which is largely dependent upon the purity of the metal. Inherently, a pure iron is homogeneous and free from localized segregations—consequently, less prone to warp. Adequate annealing to relieve all rolling strains also helps in the attainment of flatness. The critical changing point in pure iron is higher than in the case of steel; consequently it can be annealed at higher temperatures than steel with less structural disturbances than the latter.

A great deal of research has been conducted to determine the best type of sheet surface for vitreous enamelling metal. A happy medium must be found between a rough surface, from which defects may arise owing to scale or pits, and that of highly polished or cold rolled surface, the slickness of which interferes with a satisfactory bond. Extreme smoothness of surface requires a very critical viscosity, or set up of the slip, in order to maintain the proper weight of enamel distributed uniformly over the sheet surface. It is extremely difficult with excessive smoothness of surface to prevent the so-called secondary drainage. With a properly cleaned and roughed sheet surface the ideal conditions exist for ease of control of enamel distribution on the sheet surface.

A matt-like surface is most desirable which, under the microscope, shows minute tentacles which grip and bind the enamel coating to the base metal, forming a sound, solid foundation. The ground coating penetrates into the open pores of the iron and is firmly held, and, through the combined effect of these metallic tentacles reaching into the enamel and the enamel penetration into the pores of the metal, a bond is developed, the strength of which is often greater than the tensile strength of the enamel itself.

In addition to these strong adhesive forces, certain other conditions can be provided which assist the adherence of enamel. One of the more important is a certain irregularity of the interface between enamel and base metal, as mentioned above. The advantages of an irregular interface arise from the following effects:

1. It increases the surface to which adhesion can tie the enamel.
2. It breaks up those stresses which develop into multi-directional rather than simple shearing stresses.
3. The general characteristic called adherence is aided by the precipitous irregularity of the interface, producing an interlocking effect between enamel and base metal.
4. Such a surface controls drainage of the slip so as to result in a uniform weight of enamel.

Another factor favourable for generally improved adherence is that of high strength of the enamel.

In the supply of iron, uniform and consistent quality is of primary importance, as it makes possible standardization of shop practices with consequent efficiency in production.

Gauge Uniformity.

This is also of importance to the enameller. Definite temperatures are, of course, established for various thicknesses, and consequently irregular results in the enamelling process would arise to some extent if gauge variations were unreasonable.

Another problem is the necessity of securing as many pieces of finished product per ton as possible, which only can be estimated accurately when material is carefully

rolled to proper gauges. Obviously, the technique of gauge control is complicated by the inherent characteristics of hot mill practice. Compensations must be made for roll contour and for the spring in rolls. For these reasons it is necessary that commercial tolerances are allowed sheet producers, and it is interesting to note in passing that sheets are actually supplied to an allowable variation on standard 20 gauge material of *plus* or *minus* 3/1,000ths of an inch.

Research has shown that the weight of pure iron is 3% heavier than wrought iron, steel being 2% heavier. In addition on either grade of material 2% must be added for greater cross section of hot rolled sheets than is represented by the mean of the thickest and thinnest points. This means that one square foot of pure iron 1 in. thick weighs 42·02 lbs., as compared with 40·80 for wrought iron.

Accurate shearing is another feature which may become embarrassing if not supervised carefully to assure the maintenance of established tolerances, which are normally *minus* 0 *plus* $\frac{1}{4}$ in. for width and *minus* 0 *plus* $\frac{3}{4}$ to 1 in. in length. Throughout all shearing operations it is exceedingly important, as mentioned above, to avoid any contamination from oil or grease.

Drawing Properties.

There are many applications to-day, such as refrigerator linings, oven doors, and a multitude of accessory parts, which definitely do necessitate material suitable for deep drawing work. In such cases, the metal must be treated specially, and the supplier can do this intelligently only with the help of blue prints or samples of the parts.

For spinning and deep stamping best results are obtained with a normalized grain structure, which is smaller and more tenacious than that commonly obtained from box annealing. For instance, washing machines which, a few years ago were formed by the use of box annealed material, requiring several drawing operations with intermediate annealing, are now made with only one drawing operation and no annealing between the time the sheet leaves the suppliers' plant and the firing of the ground coat enamel. This excellent drawing property has made possible considerable saving by the elimination of many drawing processes and a number of annealing operations that were necessary previously.

Modern Applications.

Holloware was, of course, one of the original and most common products of the early enamelling trade, but during the last few years experts have searched for new applications. Vitreous enamelling is eminently desirable and practical where lasting durability, consistency of surface protection, attractiveness of colour, good appearance, and hygienic cleanliness are called for. Still there is an undeveloped realm in the household itself where vitreous enamelled metal has not been exploited. Drawn metal, which is light, strong, attractive, and economical, is replacing cast iron particularly for sanitary applications, hot water tanks, geysers, &c., where cleanliness is important. In England at the present time excellent progress is being made with the manufacture and sale of vitreous enamelled piping for interior and exterior drainage systems, as well as for roofing gutters, roofing tiles, and corrugated enamelled roofing. In the field of architecture the use of vitreous enamelled products has only started. Chimney pots and cowls, fireplace surrounds, mantelpieces, and numerous other building applications simply await development by those who visualize the opportunities that exist.

Give vent to your imagination for a moment, and the possibilities of the vitreous enamelling industry really appear unlimited.

Enamelling Problems.

Factors which may hamper, to some degree, the more extensive use of vitreous enamelling are the troubles commonly suffered in the application of a satisfactory enamel coating. Among difficulties which are not always traceable to the metal " copperheading " may be discussed.

During the firing of the enamel there is a normal oxidation of the metal surface which begins as soon as the iron reaches sufficient temperature to oxidize and continues until the enamel has fused. The amount of oxidation is governed by various conditions. It has been proved in our laboratories that " copperheading " is a result of oxidation of the metal in a local spot, such that excess iron oxide is produced at that spot. Under such a condition, a portion of the iron oxide dissolves in the enamel, and during cooling may recrystallize in bronze or copper coloured iron oxide crystals. There may occur all degrees of oxidation from just sufficient iron oxide to dissolve in the enamel and leave a slight depression or dark spot free from bubbles in the enamel, to a large excess of iron oxide in which there is only scale covering the metal. In the mechanism of " copperheading " something serves to make the condition whereby excessive oxidation may occur. This something may be only an air bubble in the enamel " slip," poor cleaning practice in which dirt forms gas and opens up the enamel coating, pits in the metal not properly cleaned, hard firing of the enamel, and even the flowing characteristics of the enamel itself, as well as many other conditions. The metal is often blamed for the trouble, but microscopic evidence has shown that actually the metal is rarely at fault. " Copperheading " has been associated definitely with the enamel used, cleaning practice, and other conditions, so that " copperheading " may occur as a result of many conditions unrelated to the metal itself.

Similarly " fishscaling " of enamel has many causes. It is true that proper attachment of the enamel to the metal will usually prevent this trouble. However the metal, though often blamed, may not be the inherent cause. The cleaning of the surface, the proper firing of the enamel, the proper range of expansion of the enamel, may all affect the strength of the attachment of metal and enamel and thus cause " fishscaling." Chief causes which have been advanced are chemical balance of the enamel, improper smelting or milling, failure to stir liquid ground coat enamel frequently, improper pickling of iron, underburning or overburning, and leaky muffle furnaces.

" Reboiling and black specking " are troublesome defects which originate from many causes, some of which are well defined. Reboiling of enamel is that boiling of the ground coat when the temperature of the piece passes through the range 590° to 650° C., when the ground coat is refired with or without cover coats. The cause of reboiling is closely associated with those factors which control stresses in the enamel, since such things as exceedingly slow heating through the fusion range of the enamel or slow cooling tend to prevent it. Annealing at 510° C. for 24 hours tends to prevent a reboiling condition, or the use of light-weight ground coats properly fired. Many factors show conclusively that reboiling is associated with a fracturing of enamel and a subsequent rise and breaking of a gas bubble which may form black specks in the enamel.

The proper strength of the enamel is developed only with difficulty when heavy coats of enamel are used, and we believe heavy coating to be contributory to reboiling. The normal thickness of the ground coat is generally agreed to be 0·003 to 0·004 in., and if it is heavier trouble may be expected. Once reboiling occurs it is difficult to cover with white coats, as reboiling probably will be repeated with each successive firing. The heavier the enamel coat becomes, the greater likelihood of reboiling.

It has been noted that experimental firing at temperatures of about 980° C. will often cause the enamel to show reboiling, although samples fired with the same enamel and metal at 870° C. do not develop the condition. It seems quite probable that high-temperature firing may be contributory to black specking. Heavy gauge metal is also more subject to reboiling than lighter gauge, and the conditions in general may be controlled by the control of factors which influence stress formation in the enamel layer. " Copperheading " condition is often associated with reboiling, and it seems possible that such oxidation may occur during the time of breaking of a few of the reboiling bubbles.

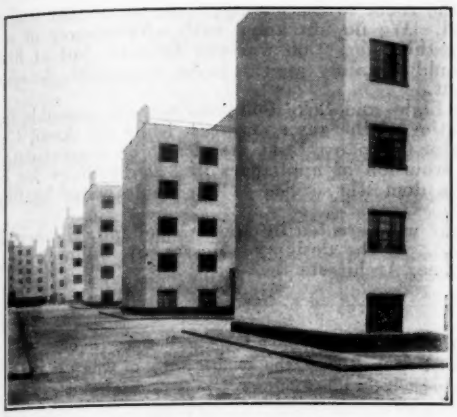
A further defect often ascribed to metal is blistering. There are, however, many faults besides unsatisfactory base metal which cause this troublesome condition, as for example, foreign matter on sheet surface; too heavy enamel coating which prevents free escape of gases; underburning, which fails to free the enamel coating of imprisoned gases; improper firing, which scorches the enamel on light sections and leaves blisters on heavily coated areas; contaminated enamels. While the sheet metal manufacturer can contribute to a limitation of blistering by supplying uniformly clean, homogeneous iron, the majority of the causes mentioned above are beyond his control.

Conclusion.

The desirable qualities of a high grade enamelling iron may be summarized under the following headings:

1. Uniformity of structure and analysis.
2. A clean open grain matt surface that grips and absorbs the coating.
3. Well de-gasified iron that reduces to a minimum the risk of pinholes, blisters, &c.
4. Homogeneity and uniformly processed to minimize the risk of distortion and warping.
5. Weldability and good working qualities.

Enamelling iron is not a standardized product, but a carefully developed material to meet the specialized requirements of the enamelling industry. Consistently uniform satisfaction can be given only when the maker is in full possession of the enameller's individual needs, and the changes which he makes from time to time. We believe that the Institute of Vitreous Enamellers of Great Britain will contribute much to the progress of the Industry.



A General View of the Estate.

Gas Provides Hot Water Requirements in 320 Flats

Instantaneous Automatic Hot Water at Every Tap for Tenants in New Working-Class Dwellings

Considerable interest is being displayed in the Industry at the present time in the provision of gas equipment for the large blocks of flats for working-class families who are being re-housed under the various slum-clearance schemes throughout the country.

The object of the building firms concerned with the erection of these blocks is, of course, to provide all—or, at any rate, as many as possible—of the essential domestic services ready installed in the completed dwellings, the interest on the capital cost of such installations being included in the weekly rents. Very keen competition, therefore, exists for the contracts involving the supply of lighting, heating, cooking, and water heating appliances, which may well, in the aggregate, run into many hundreds for a single block of flats.

We have from time to time referred in these columns to instances where gas has been successful in providing all or some of these services—a notable example being that described in a recent issue in connection with Sassoon House, Peckham. Here it will be recalled that the South Metropolitan Gas Company have been responsible for providing all these services in a very efficient manner.

Princess Alice House, Kensington.

Then, again, Princess Alice House, Kensington, has been equipped by the Gas Light and Coke Company with gas for all purposes, this building embodying eighty working-class of flats of from two to five rooms each. Special chromium-plated lighting fittings are installed in each flat, three of them being switch controlled—namely, in the hall, scullery, and living-room. Catalytic switches are employed. A gas cooker, mottled enamel wash-boiler, and two gas mantel registers are also fitted in each dwelling, while gas additionally provides the lighting of the staircases, balconies, and yards by means of automatic clock-controlled lamps.

Evelyn Court, Hackney.

Another example which we had the opportunity of inspecting recently is Evelyn Court, Amhurst Road, Hackney, where no fewer than 320 flats have been erected. These are in eight blocks of thirty flats each and two of forty each, consisting of three and four room sizes at weekly rents ranging from 15s. 9d. upwards.

While gas does not figure so largely *per flat* as in the other two installations to which we have referred, it is nevertheless gratifying to find that gas provides the complete hot water requirements in all 320 dwellings, as well as the whole cooking load, while a further interesting installation in connection with these blocks is the gas-heated drying rooms. These are equipped for the general use of tenants who desire to do their own laundry work.

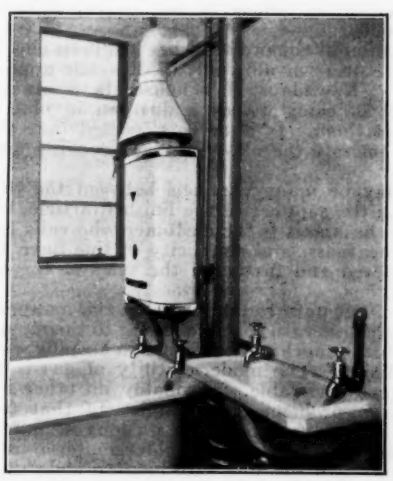
Dealing first with the hot water supply, this is provided by an "Ascot" multi-point heater, which is installed in the bathroom. This appliance is attractively finished in white porcelain enamel, and supplies hot water instantaneously to bath, lavatory basin, and kitchen sink. Each heater is vented individually by means of a suitable flue pipe terminating in a "Ventile" outside the bathroom.

In each kitchen a G.L.C. gas cooker has been fixed, this model having white enamelled oven door panels and being complete with a small gas governor.

Gas-Heated Drying Rooms.

There are altogether eight drying rooms which have been provided for assisting tenants in their laundry work, and each of these rooms is heated by two 10-column Wright's gas radiators, fitted with "P.C." cut-off valves and vented by means of a "Urastone" flue pipe. Each drying room has its own air thermostat coupled up to the radiators, embodying a graduated scale which may be set to give any desired temperature from 32° to 90° F. These thermostats are by Messrs. Cookers and Geysers, Ltd., and provide a very efficient drying installation.

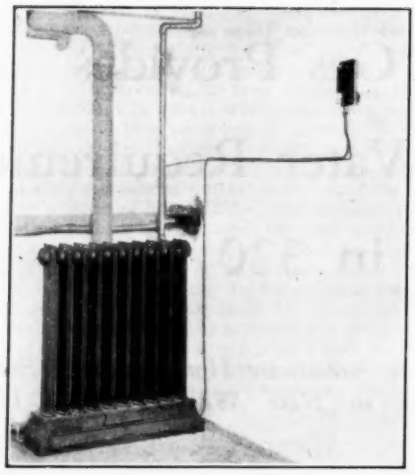
Save in the living-rooms, there are no flues in any of these flats, and as the construction is of reinforced concrete throughout there is no possibility of running under-floor or otherwise concealed gas piping in the event of any additional gas apparatus being required—particularly for bedroom heating purposes. We therefore inquired, as a matter of interest, what would be done if a tenant desired gas heating in any of the rooms; and a somewhat ingenious suggestion was made in this respect.



A Corner of the Bathroom, showing the "Ascot" multi-point gas water heater fixed over the bath and supplying instantaneous and continuous hot water to bath, basin, and sink.

Gas *via* the Picture Rail.

The picture rails round the rooms in these flats have been specially designed to stand slightly away from the face of the walls, thus effectively abolishing the usual groove which is so apt to harbour dust and germs. Furthermore, these rails take the form of ordinary hollow piping of about ½ in. diameter; so it would be a simple matter, we were informed, to carry the gas supply *through the picture rail*, thus dispensing with the necessity for further piping, which, for reasons stated above, cannot be concealed. A single pipe from the "rail" down one



corner of the room to the gas appliance is all that would be required. We do not know with what degree of responsibility this suggestion was put forward, but at first sight it would certainly appear to be a perfectly feasible arrangement.

The Gas Light and Coke Company were responsible for the installation of the gas apparatus, while the Ascot Gas Water Heater Company, Ltd., are also to be congratulated upon the provision of appliances in 320 dwellings for so important a domestic service as the whole water heating load.

The blocks were erected by Messrs. Holland, Hannen, & Cubitts, Ltd., to the design of Messrs. Sir John Burnet, Tait, & Lorne, Architects.

The photograph on the left illustrates the Gas Radiator in one of the Communal Drying Rooms, the temperature of which is automatically controlled by the "Perfecta" remote control air thermostat seen on the wall on the right.

The Application and Use of Colour for Modern Gas Appliances

A Paper read before the Manchester and District Junior Gas Association, Dec. 5, 1934.

By W. A. LOWE, Director, Donald Macpherson & Co., Ltd.

The subject of colour in the home has been given considerable prominence during the past ten years, not because the desire for colour was new, but because means of satisfying this desire had only recently been forthcoming. The enticement of colour cannot be overstressed—colour sells the goods.

The question of coloured finishes has been closely studied by manufacturers of all kinds of domestic appliances and hardware. Nowadays, if a housewife wants a coloured tray, a set of canisters, or a dustpan in blue or green, she can get them. Is it to be expected that she will be willing to tolerate the old-type black cooking and heating appliances?

There may be many channels between the producer of finishes and the supplier of the finished article, but all the way down the line it is the customer who calls the tune.

Colour, neatness, and simplicity of line have to a great extent fostered and furthered the sales of these domestic appliances.

Are there not unfortunately to-day too many gas undertakings too conservative, still clinging to the mourning note of the old black finish? This is not in keeping with modern gas advertising. The modern utility of gas is judged by the appliances available. Probably no other industry is faced with a problem quite similar to that of the Gas Industry, which, as a result of its long standing, has on hand an enormous amount of older material which must either be brought into line with modern ideas or scrapped. Certain it is that if old black cookers and fires are left in service they constitute the finest advertisement of the electrical opposition.

Now is the time to temper conservatism with enterprise. To-day, more than ever before, and particularly with women buyers, the finish—the coloured finish, to a large extent—sells the article, and though the efficiency of gas is undoubted, the "fillip" a colourful showroom can and does give to gas sales has to be experienced to be believed.

We have the experience of one large gas company with many black fires on hand which they tried to clear at £1 each, whereas when coloured they were quickly sold at £2 each—besides clearing this stock it is reasonable to suppose that the gas sales were thereby increased.

Other large undertakings with good-class consumers have found it helpful to supply fires finished to customers' requirements at a small extra charge—any tile, piece of tapestry, carpet, &c., can be quickly matched.

This service is much appreciated, leading in many cases to the installation of fires in other parts of the house. Gas fires can be stocked with a grey primer coat and when required finished in the colour chosen by the consumer. An enterprising Midland company, in conjunction with the local builders, has standardized a range of fifteen colours for their gas fires in keeping with the tiles used throughout the housing schemes. An efficient heating unit, harmonizing with the colour schemes, is thus installed at a low cost.

The sales help and service offered by these coloured appliances can only be rendered efficiently if the staff concerned have trained themselves to a true appreciation of colour and the effects to be obtained by contrasts and blends.

The public need colour education, and if gas undertakings will see that their sales staff have a true understanding of colour and its principles of application, and equip their showrooms with fireplaces of modern design, outstanding and appealing, they will be in a position to render service hitherto not attempted.

Development of Heat-Resisting Colours.

Some few years ago a prominent gas engineer asked us to produce a white enamel that would resist the heat of a gas cooker. He required such an enamel to improve, at low cost, the appearance of his black cookers—to help him meet severe electrical competition.

For over fifty years we had been manufacturing Chinese, and later synthetic, enamels, with the result that a good deal of experience was available. Modern chemistry supplied a wider range of raw materials, variations in their purity which naturally occurred were eliminated, and finally it was possible to control chemically the type of enamel we wished to produce.

Having found a lacquer to withstand high temperatures, it was necessary to discover colours which were unaffected by similar conditions. Many of the older and cheaper types were useless and a new range of pigments was employed, some of them rare and expensive.

Difficulties had still to be overcome to make the new material easy to apply, the extent of its adoption largely depending upon this factor. As a result of this experience, the material is almost foolproof in application, and represents the most rapid hardening of all modern heat-resisting finishes.

The new heat-resisting lacquer was first used on gas fires and was an immediate success. It withstood all tests and gave the operator a means of artistic expression in the

production of a hitherto unknown range of decorative effects on fires.

Cooker Renovation.

It was realized that the next gas appliance requiring "colour" was the cooker. The problem here was somewhat different, higher temperatures were met with, the surface of the metal contained a large amount of grease, and the finished article had to withstand continuous cleaning.

Some of the early difficulties in cooker renovation were traced to the incomplete removal of grease or rust which resulted in "peeling" of enamel at a later date; where a caustic bath had been used, incomplete washing resulted in some free alkali being left which later affected the finish, and discoloration took place around the door and door frame.

Correct Cleaning Methods for Cookers.

Cleaning is essential to the success of all lacquer finishes and should be given every consideration when laying down a plant. As a result of the collaboration of the Gas Industry, this problem was investigated from various angles—degreasing, caustic baths, sandblasting, and incineration. By the experience gained from all these methods, it was found that the incineration was easily the most satisfactory. The major part of dismantling the cooker and the replacement of the lagging is avoided, while the cost is cheaper than by any other method. After heating for 20 minutes at a temperature between 700°-800° F. all grease and old black are burnt out from the pores of the metal.

When cold, the cooker is mechanically or hand wire brushed or sandblasted. It then presents an excellent surface for the reception of the priming coat.

In designing a plant for the treatment of gas appliances, the handling operation should be reduced to a minimum. A gas cooker is a heavy article and the output will be considerably reduced if it has to be lifted by hand. Runways fitted with small trucks on which the cooker is stoved, running direct from the spraying booth to the stoving ovens, should be arranged, the latter having an exit on the far side which permits unloading into the assembling shop.

In the case of gas fires, spraying is carried out on a revolving turntable, the fires then being loaded on to a frame and run into the stoving ovens.

The stoving period is half an hour at 220°-250° F., but in the case of articles which have a considerable thickness of metal, the time taken for the article to reach the temperature of the oven should be taken into consideration, while thin sheet-metal fires should be allowed a short air-drying period before stoving.

Types of Finish.

These can be grouped as follows:

Fires.—(1) A plain ground colour shaded either with a metal powder or colour in contrast or harmony, the shading usually being carried out on the outer edges and projecting points of the fire.

(2) Multi-coloured effects, the articles being first sprayed with the basic colour which is then partly obliterated by other colours applied with the spray gun through masks of varying patterns.

(3) A contrasting colour to the wet or still tacky ground coat is sprayed in the form of large or small spots. In the case of multi-coloured effects, several coloured "mottling" lacquers are employed.

Cookers.—Finishes which through extended use have proved to be the most effective are self oak mottled light tan, meerschaum, oxi-di-silver, self greys, self browns, and self greens.

The finishing scheme is as follows:

Meerschaum.—The cooker is treated with the primer colour coat, shaded with brown lacquer on the outer edges, oven door and frame, then followed with a coat of lacquer. Stoving at 250° F. for half-an-hour completes the operation.

Self Oak and Light Tan.—The primer colour coat of self oak is applied followed by mottling with light tan, the latter effect being obtained by reducing the air pressure on the spray gun to a point when incomplete atomization of the lacquer results. After lacquering, the cooker is stoved at 250° F. for half-an-hour.

Oxi-di-Silver.—The first stage is a primer ground coat sprayed on and stoved or air dried. The oxi-di-silver is now applied, shaded according to the design of cooker, and the latter stoved at 400° F. for one hour. To complete this scheme the cornice should be burnished, the taps chromium or nickel plated, a black Bakelite handle fitted, and the grids and burners finished in heat resisting black, shaded with oxi-di-silver. One of the most prominent Undertakings in the South reports as follows:

"We are using your oxi-di-silver finish for modernizing our old black cookers with very satisfactory results; in fact, we are pleased to say that it has been most helpful to our Sales Department in combating electrical competition, and in many cases has assisted in the displacement of the electrical appliances."

For slot consumers the finishing of cookers by any of these methods represents a solution to the difficulty of renovation, since, unlike vitreous enamel, the complete cooker can be re-sprayed in the gas undertakings' workshops, when it is again equal to new.

Water Heaters.—The renovation and colouring is similar to the method adopted for gas fires; white, of course, is used, but any colour can be readily produced to harmonize with the bathroom or other room colour scheme.

Brackets, Pendants, &c.—By treatment with coloured lacquers, all fittings can be made equal to new, while existing stocks of lighting fittings can be made more attractive to promote their sale.

Never before has the demand for colour and decoration in the home been so great as it is to-day, and it is the insistence that the home should be brightened, coupled with the development of new finishes as the result of research work, that has brought into being these new materials.

Discussion.

The PRESIDENT (Mr. James Carr), in opening the discussion, stated that colour undoubtedly sold the goods, and the Gas Industry could not afford to ignore this appeal. Although it was essential that their mains should be protected with bitumen solutions, there was no reason whatever why black should be the predominant colour for cookers, fires, &c. Present day competition demonstrated that appliances should conform to colour schemes, and there was no difficulty in providing attractively coloured appliances.

Mr. N. PARTINGTON (Oldham) inquired if a paint could be manufactured that would stand on a main that was continuously heated to a temperature of 400° F.

Mr. A. L. HOLTON (Manchester) was of the opinion that it would be generally agreed that colour was undoubtedly a better proposition than the old black finish—so he would not discuss that point. Since cast-iron was porous it was not surprising to learn that incineration was considered to be the best way of cleaning a cooker prior to spraying. Paint should be looked upon as a definite engineering material, and he would like to inquire if there was any standard paint by which other paints could be judged. Exposure tests had been carried out in Manchester by painting the various samples on the top of a holder, but it was of paramount importance in testing paint that they should be applied under identical conditions to obtain comparative results. It would be generally conceded that even a damp atmosphere was detrimental to the life of paint. Mr. Holton said that the removal of mill scale was a controversial question, and he would like to have Mr. Lowe's views on this point and also whether he recommended the application of a coat of oil to the metal in the early stages. Owing to the fact that structures constantly required painting, cheap paint of an inferior quality was often adopted. Such a procedure was quite wrong.

Mr. R. W. MALONE (Bury) stated that he had installed an incinerating plant and was now, and had been for some considerable time, spraying his appliances, not only to the satisfaction of the consumers but also to the benefit of the finances of his Undertaking. He would be exceedingly pleased to show any interested members over his plant and demonstrate the efficiency of the process.

Mr. H. W. HODGSON (Liverpool) was of the opinion that there was a tendency when cleaning with caustic for the enamels to peel. In Liverpool an incinerator had been installed and cookers sprayed in a similar manner to that demonstrated during the afternoon. The cookers had met with a good reception from the consumers. In six months' time they would be examined, but, from past experience, he had no doubt that the condition of the paint would fulfil all their expectations.

Preaching to the Converted.

Mr. J. T. HAYNES (Rotherham) expressed his pleasure at visiting the works, and also at listening to the paper, but Mr. Lowe was preaching to the converted, at least so far as he was concerned. Their business was to give satisfaction to every consumer. The Gas Industry must realize that it was up against electrical competition, particularly in regard to cookers. Some were content to say that the gas cooker was far superior to the electric cooker and then leave it at that; but the result of recent tests conducted by "Good Housekeeping" on three gas and three electric cookers had rather shaken that complacent attitude. It had been found:

1. That there was very little difference in convenience between gas and electricity.
2. Gas was found to be slightly quicker on the average.
3. The cost of electricity at ½d. per unit was approximately equal to gas at 8½d. per therm. The difference in cost between the two for the average householder for cooking would be slightly in favour of gas.

It was therefore a fallacy to say that gas was going to be used because it is so much superior. Two points, however, on which gas service could be improved were: (1) Use of more

attractive modern appliances; and (2) the price of gas. If a consumer had an old black cooker in use there were two ways of keeping the electric cooker out. First, by renovating, or, secondly, by purchasing new cookers. Rotherham was in a position to renovate at a total cost of 25s. per cooker; but this cost could be lowered because the plant was not being utilized to its fullest capacity. New cookers, however, would cost £5 each. Quite apart from the difference in the foregoing costs, it must not be overlooked that by renovating the cookers the writing down of " dead " capital was avoided.

Mr. J. ALBINSON (Manchester) thought that as a Junior Association sufficient attention was not being paid to the sales side of the Industry. While colour was an advantage in helping to sell gas appliances, it was also important to bear in mind that the use to which cookers were put very largely depended upon the price charged for gas.

Mr. W. P. SMITH (Fleetwood) said that since simple hire was almost inevitable it was a decided advantage and economy to spray cookers, owing to the poor condition in which some appliances were returned.

Removal of Graphite.

Mr. A. ALLEN (Manchester) doubted if such substances as graphite or black lead would be removed from a cooker after heating for twenty minutes at a temperature of 700°-800° F. as suggested by Mr. Lowe in his paper. Possibly, however, it would enable the graphite, &c., to be removed by wire brushing. Had consideration been given to the use of a filler for the purpose of sealing up the pores of the metal prior to the use of a priming coat? Extensive tests had shown that a good red lead paint appeared to be the best for iron and steel work, but many factors must be taken into consideration. Aluminium paint should never be applied to ironwork direct, but if applied on a coat of red lead paint it would be found most difficult to remove, even with scrapers. It was surprising to note that a single coat of even the best makes of paint on the market broke down within 10 days, thus stressing the importance of applying a second or even a third coat of paint. Mr. Allen suggested that the second coat should be applied within three months and the third coat within eight months of the first coat. At Droylsden there was an 80 year old gasholder in good condition with side sheets which had been treated with tar. In scraping down to the metal, however, it was found that red lead and oxide paints had been applied prior to the successive coats of tar. Trouble might be expected if tar were applied direct on to the metal.

Mr. H. PLATT (Bolton) asked Mr. Lowe if lanoline paints were of any use in the Gas Industry, and what was the best type of paint to use where oxide dust was in the atmosphere? Did the Author recommend the scraping of gasholder sheets, followed by a 50/50 mixture of boiled oil and turpentine?

Mr. D. BENSON (Bolton) asked if very much had been done in the way of utilizing rubber as a body for paint.

The Author's Reply.

Mr. LOWE, in reply to the discussion, stated that it was difficult to reply to Mr. Partington without being in full possession of all the facts. Great stress had been laid on the necessity for cleaning, and if this precaution were not taken trouble would result—*e.g.*, if there were traces of caustic, flaking would probably occur. It was not claimed that the spraying of cookers, &c., had reached perfection, but it had most definitely become a commercial proposition, as several members of the Gas Industry had testified during the evening.

In reply to Mr. Holton, he said that there was no universal standard of paint, although they had a standard of their own by which they made comparisons. Mr. Lowe stated that he did not intend entering into a discussion in regard to the removal or otherwise of mill scale; adherents were to be found both for and against the practice. In his opinion, much depended upon the metal itself. In some cases mill scale did not come loose, and it was satisfactory to paint over it provided the correct procedure was adopted in regard to time, conditions, and quality of paint. In other cases the mill scale came away very easily and must be tapped and brushed off before painting. Referring to the points raised by Mr. Allen, a filler was sold for filling up the pores of metals. In painting gasholders, Mr. Lowe thought it advisable, whenever possible, to apply successive coats of paint as soon as the last coat was dry and not to wait for a few months to elapse.

Mr. ARCHER (Chief Chemist of Messrs. Donald Macpherson & Co., Ltd.), replying to Mr. Platt, stated that lanoline, being non-drying, had wonderful preserving power on bright steel parts. It was therefore used extensively on machinery that was to be exported, particularly since it acted as a lubricant in addition. He doubted the efficacy of using a 50/50 mixture of boiled oil and turpentine on gasholder sheets. Rubber paints contained only about 2/3% solids, and there was not sufficient information available as yet to justify their adoption. There would be no difficulty in supplying a paint to stand up to the conditions stated by Mr. Partington.

A vote of thanks to Mr. Lowe was proposed by Mr. PARTINGTON, and seconded by Mr. BENSON.

The Work of an Industrial Centre

A Paper read before the Southern Association of Gas Engineers and Managers at the Autumn General Meeting in London on Nov. 30, 1934.

By W. DIETERICHS, Assoc.M.Inst.Gas E., of the Gas Light and Coke Company

(*Continued from p. 762.*)

Periodical Reports.

The G.L.C. Centre was already organized before the scheme came into being, but the staff had to be augmented to cope with the increased work which, quite naturally, was placed upon it when the scheme started. In view of the number of inquiries which we had received before the inception of the scheme from various undertakings, it was thought that whatever information became available at Watson House regarding industrial work—*i.e.*, results of tests of standard plant, reports on special installations or development work, &c.—should be circulated in the form of a monthly or quarterly report in order that all contributing undertakings should be in touch with the work of the Centre. The same scheme has also been adopted by certain other Centres. In addition to this, these Centres exchange their monthly or quarterly reports through the Central Bureau, so that the contributing undertakings not only get the benefit of the work of their own Centres, but are also kept in touch with the progress which is being made by other Centres.

During the course of this year the G.L.C. Centre has issued over sixty reports on subjects which include bakers' ovens, conversion of solid fuel-fired coppers, oxy-coal gas cutting, sterilization of milk bottles, doughnut-frying, laundry irons, heat-resisting steels, and many others. A typical report on a sterilizing cabinet for milk bottles is reproduced below:

THE GAS LIGHT AND COKE COMPANY

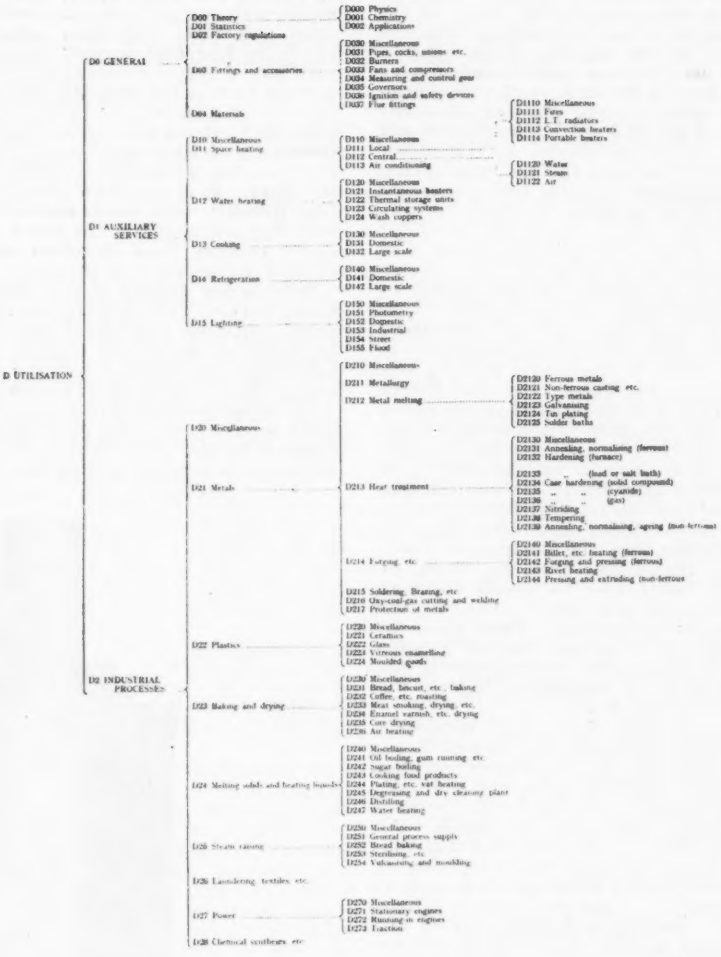
INDUSTRIAL CENTRE, WATSON HOUSE, LONDON.

STERILIZING MILK BOTTLES.

An appliance for sterilizing milk bottles on the lines described in the article No. 34/1/2 has now been produced and is in actual use for this process. The arrangement is shown in the accompanying illustration, and the appliance is seen to consist of two parts, a steam generator and a sterilizing cabinet. The boiler is solidly built with a shell of welded $\frac{3}{16}$-in. mild steel plate surrounded by slag wool insulation and a mild steel outer case. The burner is of the luminous type, and in place of the multiple tubes the boiler has a single flue channel provided with a baffler to promote heat transfer. In addition to the usual fittings an indirect-acting automatic gas control is supplied, and as the working pressure is only 1 lb./sq. in., it is possible to have an automatic water feed from a ball valve tank fitted on top of the sterilizing cabinet.*

* See Fig. 8 (to be reproduced later).

CLASSIFICATION SCHEME



The sterilizing cabinet is built of galvanized sheets, and the door is secured by a number of clamps to make it pressure tight. Shelves are provided to accommodate the trays on which the bottles are placed upside down, and a tap is provided at the bottom to allow the condensed water to be drained off. The size of the cabinet is not critical, but approximately 4 ft. 9 in. by 1 ft. 9 in. by 2 ft. 3 in. will be found reasonable for a normal sized shop. The price of the complete unit as described is £37 10*s.*

In operation the boiler is found to have a maximum gas consumption of 140 c.ft./hr., and to take 30 minutes to reach the working pressure. The sterilizing cabinet when empty takes 10-15 minutes to reach 210° F. In addition to supplying steam for sterilizing, the boiler may be used for supplying hot water for washing purposes, and to this end a connection may be made to the draw-off tap. Pending the completion of arrangements for the manufacture of this appliance it will be made at Watson House.

Filing Scheme.

To increase the utility of such reports as these and to facilitate the compilation of technical information a comprehensive filing scheme has been worked out by the Central Office in conjunction with the Centres, and this enables any information relative to the use of gas to be filed under classified headings. The scheme is set out in the following table, and it will be realized that while it is now adequate in its present form it can readily be expanded to meet increased requirements in the future. It can be used not only for the reports of the type described, but also for abstracts and cuttings from the Technical Press, test reports, extracts from correspondence, and similar material.

Installation Sheets.

In addition to this, a form of Installation Sheet has been devised on which test results of important installations can be set out in standardized form. These forms are filled in by the various Centres and forwarded to the Central Information Bureau, where they are checked and duplicated for circulation to all Centres. As time goes on each Centre will therefore amass a store of information which can be used both for compiling reports to the member undertakings and also for reference in connection with actual jobs on which the Centre is engaged.

Co-operation with Makers.

Up to this point I have been discussing the functions of a Centre in rendering direct assistance to its member undertakings; but I now come to a subject which is perhaps of even greater importance—namely, the co-operation of the Centres with the manufacturers of gas consuming equipment, and by manufacturers of equipment I mean not only the great firms of furnace and oven builders, boiler makers, and heating engineers, but also those thousand-and-one firms manufacturing appliances which require heat in any form. Quite frankly, I think the majority of British manufacturers are to be congratulated on the advance they have made in the past few years, and there is no doubt that in many processes town gas has been kept ahead of its competitors as a result of this advance. The debt of the Gas Industry to the manufacturers of equipment will be appreciated when it is realized that even in those districts where industrial departments are organized to the highest degree large quantities of gas consuming plant are being sold direct, without the assistance of the gas undertakings. But at the same time, there is still room for improvement of the gas consuming appliances, no matter what process one likes to consider, and in many cases appliance makers have been lamentably slow to improve their products, so much so that some appliances are being sold to-day which were designed more than twenty years ago and are now in obvious need of improvement.

The Gas Industry must make it clear from the start that what it wants is the best, not necessarily the cheapest, equipment. The point which I want to emphasize most in dealing with this subject is that any competition between

gas undertakings and suppliers of equipment should be avoided at all costs. Let us see what it means. Take the case of a gas consumer opening a fish-frying shop. In the ordinary course of events he obtains quotations from the recognized range-makers for the supply of an efficient range. It often happens that the local undertaking, having a workshop of its own or having the services of a local firm, offers to make a range more cheaply for the consumer. Here we have, on the one hand, a manufacturer whose sole existence depends on the profit he obtains on the apparatus, and on the other hand, we have the gas undertaking whose living depends on the profit from the fuel it sells and which can therefore afford to minimize its profit on any appliances it makes.

It is quite clear that if we compete with suppliers of equipment in this way, unless the manufacturer turns his attention to some other form of activity he will quickly be forced out of business and will turn, in self-defence, to the use of other fuels. As a result, we shall find that those who were our best friends have become our enemies. In various parts of the country, I am sorry to say, this development has already proceeded some way, and I hope you will agree with me that it is essential that the policy should be reversed. A case has only just occurred where an oven builder, with whom the Gas Industry had recently established contact, obtained an order on the area of an important gas company for a large bread-baking oven, one of the largest of that type that has recently been installed. The order was obtained without any assistance from the gas undertaking in question, and the company's representative, when he knew that a gas oven was being installed, suggested to the baker that he would do much better to purchase through the gas undertaking an oven of which they had previous experience. Even after the gas-fired oven had been installed the gas company's representative continued to disparage the performance of the oven and gave the consumer the impression that it was consuming an excessive quantity of gas.

I remember some years ago when I was made personally responsible for the Industrial Showrooms at Goswell Road, most of the equipment which was being exhibited was that made by the Gas Light and Coke Company, and the number of manufacturers who called to see me with reference to any job on the Company's area was very small. Although a certain amount of standard apparatus was supplied, more often than not the Company was supplying its own products and was unknowingly in competition with its best friends, the manufacturers. I am pleased to say, however, that since we have adopted a different policy our sale of industrial equipment has increased out of all proportion, and the good feeling between ourselves and the manufacturers has become quite mutual. In many cases where manufacturers are working on our area I am advised of all developments, and copies of the specification are sent to me in order that we can assist them to obtain the order for some form of gas-fired apparatus. I have always found that although manufacturers are accused of all kinds of faults, they are always ready to accept any suggestion which may improve their appliances.

In spite of this, there are a few specialized jobs which the manufacturers of equipment are not in a position to carry out, for which the gas companies may legitimately use their own workshops. At Watson House, for instance, the Gas Light and Coke Company has a workshop where work of this kind is carried out and where repair, maintenance, and installation work is also done.

Development Work.

Another and very important function of the Centre at Watson House is the execution of development work, the designing of appliances, and research on the use of gas for industrial processes.

The need for this work arises in various ways. In the normal industrial operations it is essential that we should be able to offer appliances having the highest possible standard of performance, and in order to do this it is necessary to make continual improvement in design; for the appliance which is satisfactory in 1934 will not necessarily be so in 1935. In the special operations, for which no standardized plant is available, development work is even more essential, owing to the number of additional problems which are thereby introduced. During the past few years we have been engaged on the development of new and the re-modelling of old appliances, and I want to describe to you in some detail a few examples of this work, showing how the need for the new appliances arose and what results have been obtained.

The Salt Bath.

There were salt baths on the market long before this design was put forward, but our continual contact with consumers using them soon convinced us that there were one or two defects which might easily be overcome. To commence with, we got into touch with a prominent heat treatment specialist, and, after ascertaining all the troubles which he had experienced, we developed, in conjunction with him, a furnace designed to overcome these difficulties. It must be realized that salt bath furnaces can be operated not only by gas, but also by oil or electricity, and the orders for these furnaces are obtained more often than not through the heat treatment specialist who is asked to recommend to his customer a furnace suitable for use with the salts he is selling. It is therefore greatly to the advantage of the Gas Industry that these specialists should be acquainted with and interested in the latest gas furnaces for the process. Designs were therefore prepared and experiments carried out on the new furnace.

After a few months of test under actual working conditions, varying defects were located in the new design and were corrected, and the design of the perfected furnace, as shown in fig. 1, will shortly be handed over to reputable firms of manufacturers for marketing. It would, of course, have been quite a simple matter to have continued to manufacture these furnaces, but no useful purpose would have been served. For one thing, it is of little financial interest to the Gas Light and Coke Company when the furnace is not being used on the Company's area of supply,

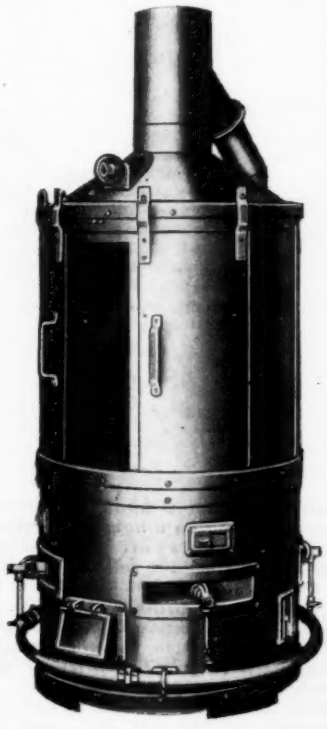


Fig. 1.—Pot Furnace.

and, even on our own area of supply, manufacturers would put forward the best furnace they had available and would naturally regard us as competitors if we put forward a furnace of our own design in competition with theirs. It is obvious, therefore, that we must help the manufacturer and give him the benefit of the development work which we carry out, and in doing so we must not exact exorbitant royalties.

(To be continued.)

Tar-Concrete Experiment on New Kirkham By-Pass.

Of the ten experimental, non-skid sections on the new Kirkham By-Pass on the Preston-Blackpool Road which Mr. Hore-Belisha, Minister of Transport, declared open officially on Tuesday, Dec. 4, two sections, each of about 300 yards in length, have been laid by the British Road Tar Association under the ægis of the Ministry of Transport.

The surfacing of one of the sections consists of two-coat tarmacadam; while that of the other is carried out in single-coat tar-concrete, British stone and British tar being employed throughout.

Economic Considerations of Gas-Fired Central Heating

A Paper read before the Western Junior Gas Association at Taunton, Dec. 1, 1934.

By H. D. SULLIVAN, of the Plymouth and Stonehouse Gas Light and Coke Company

Gas-fired central heating, though slow in development, holds distinct possibilities as a profitable source of business. This paper endeavours to assess the possibilities of gas-fired central heating in various circumstances, and though it may show that the competition for this load is almost as keen as for power, it has one point in its favour that counts with the public. It is a new development, and though requiring intensive cultivation, is more interesting to the buyer than a heating process which has been on the market for decades.

Competition in Central Heating.

In many gas undertakings it may be said that coke for central heating still forms the largest proportion of the total sales. At one time coke enjoyed a monopoly as a central heating fuel, but the last ten to fifteen years has seen the scientific application of the three mobile fuels—oil, gas, and electricity—to this purpose.

Of the three oil has made the most rapid progress in sales, and oil heating equipment is being pushed vigorously by so many firms that one would imagine the business to be too overcrowded to be profitable. There are scores of oil-burner designs on the market of which only a few can hope to maintain a steady sale.

On the basis of gross fuel cost oil is definitely our most serious competitor, and although the tax on oil has helped a great deal, gas is still higher in price, even at 4d. per therm. It has been rather difficult to obtain details of the current prices of oil deliveries, and it is evident that they vary somewhat according to the quantity purchased and the geographical situation. For the purpose of general comparison it is sufficiently accurate to take oil with a C.V. of 18,500 B.Th.U. per lb., specific gravity 0·89, and a price of 5d. per gallon, which is equal to 105s. per ton. So far as I am able to ascertain this price of 5d. per gallon may be regarded as the minimum obtainable.

This gives us a minimum gross heat cost for oil of 3·03d. per therm, which is generally lower than the price at which purified gas can be sold to make even the smallest margin of profit. (I am, of course, referring here to gas produced by carbonization at a gas-works, and not to gas bought in bulk from coke ovens.) However, if we compare net heat costs of the two fuels, allowing 80% efficiency for gas and 65% for oil, we find that oil has very little advantage—that is, with gas at 4d. per therm. Also bearing in mind the fact that heat losses due to inefficient thermostatic control and radiation from the boiler during the shut-down periods are greater with an oil-fired boiler than with gas, it is a moot point whether gas may not prove to be more economical at the prices quoted. In Table 2 it will be noted that a theoretical gross cost for oil in Column 8 is higher than the actual cost for gas. When allowances are made for greater simplicity of the gas-fired boiler as compared with the oil-fired boiler, saving in labour charges occasioned by the less frequent cleaning of the gas burner equipment and the absence of fuel storage requirements, I think a very good case can be argued for gas at 4d. per therm in preference to oil at 5d. per gallon.

Method of Investigation.

The object of this paper is to determine as far as possible the ultimate cost of heating with the various fuels, making allowances for all factors which affect the final figure. Where possible the fuel costs were obtained from actual practice, and where the circumstances prevented comparison on a practical basis the probable costs of competitive fuels were calculated theoretically.

It will be noticed in each of the four Tables of test results that allowances have been made for labour charges. It is very probable that a diversity of opinions will be expressed among the members as to the correct allowance that should be made with respect to any particular fuel. We are, however, fully aware that whatever value we may give to labour charges, the only opinion that really counts in a decision on the relative merits of the various fuels is that of the person who has the choice between them. More often than not we find that labour charges are not given their real value, usually because the introduction of a labour-saving fuel merely diverts the labour from the job of boiler attendance to any other work about the premises. Only on very large installations does one find labour allocated to boiler attendance only, which could be dispensed with by the use of gas.

In carrying out this investigation it was fortunate that three gas-fired installations were available for test purposes each, using a different type of boiler and being operated under different conditions of use. In each case the analysis was carried out as follows:

The flue gases were analyzed and used to determine the thermal efficiency of the boiler and also the amount of excess air entrained. This method of determining the efficiency is no doubt subject to criticism, but on a central heating installation it is the only practicable method available.

The volume of the building, area of walls, glass, roof, and floor were determined in order to estimate the theoretical heat requirements. Throughout each test period daily readings were taken of the maximum and minimum outside temperatures, from which the average temperature was calculated.

With these figures available it was possible to estimate the heat requirements of each building in B.Th.U. per hour. The gas consumption was checked over the test period, the exact periods of boiler operation were noted, which, together with the boiler efficiency, enabled the average heat output per hour to be determined.

Use of Special Units.

In the Tables of Results it will be seen that all calculations have been reduced to their respective values relative to the requirements of 1,000 c.ft. of space during one hour of occupancy.

It was felt that the adoption of a common unit of space would facilitate comparisons and perhaps prove useful for estimating the cost of heating in future installations. This unit is, of course, not absolutely equal in all respects when applied to different buildings. A disparity between relative areas and thicknesses of walls and glass will always be found, and the heat requirements of 1,000 c.ft. of space in one building are not necessarily the same as those of another.

However, central heating calculations are notorious for the presence of a large number of variables, and as all calculations are limited by the figure that is least accurate, this unit should serve a practical purpose.

The unit of time—one hour of occupancy—calls for some explanation. It has been used in past papers by A. H. Barker, and appears to be the most accurate time unit on which to base calculations for the cost of central heating with respect to particular buildings.

The most usual query of the authorities who are considering a new installation is—how much will it cost to warm the building for so many hours per day? Though the time required for heating up the building and the hours of boiler operation are important, they are given secondary consideration.

This hour of occupancy unit is of much greater value than one based upon boiler operation, because it constitutes the useful service rendered. A low heating cost per hour of operation is misleading if the boiler is in use for two or three times as long as the building is occupied.

Most important of all, the heating figures, based upon the period of occupancy, directly reflect the influence of the conditions under which the building is used. The conditions of use may be classified under three main headings:

(1) *Continuous Use.*

Buildings that are in use day and night, such as hospitals, requiring a constant supply of heat without cessation throughout the heating season.

(2) *Continuous-Intermittent Use.*

By far the greater majority of buildings come under this heading. It comprises all buildings

which are occupied daily for five to six days per week and closed each night.

Schools, offices, banks, libraries, shops, &c., invariably come under this heading.

(3) *Intermittent Use.*

This is confined to churches and assembly halls, which may not be used more than three or four times for short periods each week.

This brings us to a consideration of the efficiency of heat utilization and the relative periods of boiler operation under the various conditions of use. Again, for the sake of clarity, two expressions have been borrowed from A. H. Barker to illustrate the efficiency of particular heating systems. They are as follows:

$$\text{Occupation efficiency} = \frac{\text{Minimum heat required in the building}}{\text{Heat output of the boiler}}$$

$$\text{Diversity factor} = \frac{\text{Number of hours boiler is in operation}}{\text{Number of hours building is occupied}}$$

The ideal conditions, of course, would be represented by an Occupation Efficiency of 100% and a Diversity Factor of 1. Allowance must be made, however, for heat losses from the circulating system other than the heat transmitted to the rooms, and also for the heat losses during the time of heating up prior to the building being occupied. If we had a Diversity Factor of 1 the latter source of heat loss would be eliminated. As, however, all heating systems must be started earlier than the time the building is required, the extra time depending upon the rapidity of circulation and heat transmission into the building, we have to be content with less than 100% for the Occupation Efficiency.

Reasons for Variations in Results.

Turning to Table 6, in which the tests on the three heating systems are grouped, we find in Tests Nos. 1, 2, and 3 on systems operated under similar conditions of use a great difference in the Occupation Efficiencies.

It must first be said that Test No. 2 is abnormal, and the reasons for this are easily explained. The school has on it south side a large folding partition which, during weather considered to be suitable by the teacher in charge, was usually fully open during the time of the test. The influence of excessive ventilation is immediately evident in Columns 7 and 9 in the tremendous amount of heat required and the abnormally low Occupation Efficiency.

I should like to draw your attention to the increase of 39% in the Occupation Efficiency shown in Test No. 3 on the same system. This was obtained by eliminating excessive ventilation and only allowing the folding partition to be opened on exceptionally warm days. The difference of 17% between Tests Nos. 1 and 3 may be accounted for to some extent by the fact that the library is occupied 11 hours each day as against 7 hours at the school.

Effect of Type of Circulating System.

The chief difference, however, is accounted for by the fact that the library is equipped with a modern circulating system under forced circulation, enabling pipes no larger than 2 in. diameter to be used. The speed of heat transmission is so good that circulation of hot water is obtained through a long circuit within the half-hour, and it is possible to shut down the boiler for periods during the day and so obtain a low Diversity Factor of 0·7 and an Occupation Efficiency of 82·0%.

In the school an old circulating system is in use, composed of 3 in. diameter C.I. pipes, and no radiators, the whole system being under gravity circulation. Accurate figures for the Diversity Factor were not obtainable in this test, but there is no reason to believe that they were much lower than the 1·34 in the Test No. 2. The Occupation Efficiency of 65·5% may be relied upon to represent an average for this particular type of system under normal conditions of ventilation.

Intermittent Heating.

Turning to Test No. 4 we find a system operated under quite different conditions. This is a church used for the usual Sunday services and on one or two evenings each week. In common with many of the older churches, it has a circulating system composed of 4 in. diameter ring mains, with one or two large capacity radiators connected to them. Most of the pipes are carefully hidden away under gratings in the floor and efficiently insulated with dirt and fluff which in the passing of years has accumulated there!

No forced circulation is used, and therefore the circulation of hot water is very slow indeed; a complete circuit to give a return temperature of 120° F. takes about 3-4 hours.

Under such conditions we are not surprised to get an Occupation Efficiency of only 24·0% and a Diversity Factor of 1·9. It is evident that the amount of heat passed into the building for the short periods of use is out of all proportion to the duty obtained from it.

General Inferences.

In the above case we are met with peculiar difficulties which cannot be solved by merely increasing the rapidity of heat transfer. Even with the most modern circulating system obtainable we are still faced with the fact that for intermittent occupancy in buildings of large volume the value of the quantity of pre-heat constitutes too large a proportion of the total heat supplied. When 75% of the total heat is actually wasted under intermittent conditions of heating the difficulty of obtaining an economical heating service will be appreciated.

Many of the Plymouth churches use gas radiators, and some of them for reasons of economy are equipped with an inadequate number for efficient heating. In such cases I find that the slowness of heating is such that the long period of pre-heat usually results in a high gas consumption giving very little return in increase of temperature. Unjustified criticism is often directed against gas heating on this score, whereas a marked improvement could be obtained by the installation of the correct number of radiators.

Taking a long view of the situation, it is essential that the Gas Industry should use its influence to direct central heating modifications and improvements on lines which will not be inimical to the application of gas for this purpose. We are forced to the conclusion that in order to develop the use of refined fuels for intermittent central heating in buildings of large volume we must abandon the old idea of warming the air content as a whole, and concentrate on the careful distribution of radiant heat surfaces adjacent to the occupants of the rooms. It is a well-known fact that by use of low-temperature radiating panels placed in the most advantageous positions comfortable conditions of warmth may be experienced in a room which has an actual air temperature of below 55° F.

The exploitation of this fact in the planning of electric tubular heating systems has given satisfactory results in some instances without any attempt being made to heat the total volume of air in the building. If this can be done with a fuel which is on the average twice as costly as gas there is not the slightest reason why it may not be done equally well from a technical point of view by gas, and at a considerably lower cost.

When heating engineers give up the conservative method of calculating so many square feet of radiating surface per 1,000 c.ft. of space and consider each particular scheme separately, giving closest attention to the judicious distribution of radiating surfaces in relation to the occupants of buildings, it will be a great help to the advancement of gas-fired central heating.

Unfortunately the opportunities of assisting in the planning of central heating schemes do not often come the way of gas salesmen, and we are usually faced with the task of adapting our commodity to existing systems. We have seen that the most promising field is where the conditions of use are intermittent-continuous. This is the field in which the fuel costs are likely to be lowest. Given a good circulating system on the lines previously indicated, we can obtain in this field of business the fullest benefit from those advantages which are peculiar to gas. Here the value of flexibility of boiler operation is most evident, and where the difference in fuel cost between gas and coke may be greatly reduced.

In Table No. 2, Test No. 1, the ability to shut down the boiler increased the Occupation Efficiency from about 56% to 65%. This is proved as follows: If the boiler had been in operation during the whole period of occupancy it is reasonable to assume that the output of heat during the extra hours would have been very little less than the average calculated per hour of operation, and the Occupation Efficiency would have dropped as follows:

$$82\% \times 0{\cdot}7 = 57{\cdot}4\%$$

On the question of relative costs of gas and coke, Table 3 shows that under the most favourable weather conditions the flexibility of the gas boiler may actually result in a reduction of fuel cost. Test No. 2, however, emphasizes the fact that flexibility of heat output cuts both ways, and that abnormal ventilation must be avoided.

It is evident that the presence of so many variable factors makes it exceedingly difficult to evolve any accurate method of estimating the probable heating costs of any building of a particular type. The most useful figures in the final Table No. 6 are the Occupation Efficiencies of Tests Nos. 1 and 3. They show that under normal conditions of ventilation and careful supervision the efficiency varies according to the design of the circulating system, and may be found between 65% and 80%. Anything more definite cannot be claimed from the results and would only be supposition.

In what is shown to be the most suitable field for gas-

fired central heating we have ample scope for the testing of our selling ability. Except in the most favourable circumstances we are competing against coke and oil, which are lower in fuel cost, and the task of persuading the prospective purchaser that the compensating advantages are worth while is no easy one.

On the other hand, we are faced with the modern appeal of electric heating, which to the non-technical mind sounds cheap at the mention of ½d. units. But except where money is no object electricity is not competitive, and will not become so until considerable reductions are made in its price. There is an increasing tendency to adopt mobile fuels for central heating purposes, and gas, with its advantages of simplicity in operation and control, together with the absence of fuel storage arrangements, should successfully compete in this sphere of business, provided it can be sold at a price reasonably competitive with fuel oil. It is to be hoped that we shall take every advantage of the opportunities afforded, and not allow our competitors to be first in the field.

TABLE NO. 1.

System.	Type of Boiler.	Rated Output per Hour.	Thermal Efficiency.	Heat Losses Due to Excess Air.	Type of System.	Volume of Building.	Area of Radiating Surface.
No. 1	4 B.H. Spencer-Bonecourt boiler	1,000,000 B.Th.U.	77·7%	4·0 %	2 in. W.I. pipes and modern radiators under forced circulation	196,000 c.ft.	3,800 sq. ft.
No. 2	Ideal No. 2GB6.	225,000 ,,	78·75,,	3·9 ,,	3 in. C.I. pipe system; no radiators. Gravity circulation	39,100 ,,	423 ,,
No. 3	No. 4A Vesta auto-control boiler	400,000 ,,	83·76,,	1·27 ,,	4 in. C.I. ring main system. Gravity circulation	131,000 ,,	1,800 ,,

TABLE NO. 2 (*Test No. 1*).—*Lancaster Public Library and Museum.*

[Test Period Nov. 1, 1932—April 21, 1933.]

1 Fuel.	2 Fuel Costs.	3 Gross B.Th.U. per 1d.	4 Boiler Efficiency.	5 Net Heat Output of Boiler per 1,000 C.Ft. Space per Hour of Occupancy.	6 Heat Input to Boiler per 1,000 C.Ft. Space per Hour of Occupancy.	7 Cost of Net Heat Output from Boiler.	8 Cost of Heat Input to Boiler.	9 Gross Cost of Heat Input to Boiler, including Labour.	10 Ratio. Gas = 1.
Gas* . .	4d. per therm	25,000	78%	2,060 B.Th.U.	2,650 B.Th.U.	0·083d.	0·106d.	0·111d.	1·0
Coke . .	30s. per ton	77,780	55%	2,830 B.Th.U.	5,140 B.Th.U.	0·036d.	0·066d.	0·089d.	0·8
Oil . . .	105s. per ton	32,000	65%	2,270 B.Th.U.	3,490 B.Th.U.	0·071d.	0·109d.	0·131d.	1·18
Electricity .	½d. per unit	6,824	100%	2,060 B.Th.U.	2,060 B.Th.U.	0·302d.	0·302d.	0·302d.	2·72

* Results obtained in practice.

TABLE NO. 3 (*Test No. 2*).—*St. Mary's School.*

[Period 5 days March 13–17, 1932, inclusive.]

1 Fuel.	2 Fuel Costs.	3 Gross B.Th.U. per 1d.	4 Boiler Efficiency.	5 Net Heat Output of Boiler per 1,000 C.Ft. Space per Hour of Occupancy.	6 Heat Input to Boiler per 1,000 C.Ft. Space per Hour of Occupancy.	7 Cost of Net Heat Output from Boiler.	8 Cost of Heat Input to Boiler.	9 Gross Cost of Heat Input to Boiler, including Labour.	10 Ratio. Gas = 1.
Gas* . .	6d. per therm	16,666	79%	4,290 B.Th.U.	5,450 B.Th.U.	0·257d.	0·327d.	0·343d.	1·0
Coke* . .	30s. per ton	77,780	55%	6,190 B.Th.U.	11,260 B.Th.U.	0·081d.	0·145d.	0·192d.	0·56
Oil . . .	105s. per ton	32,000	65%	4,720 B.Th.U.	7,260 B.Th.U.	0·147d.	0·227d.	0·272d.	0·79
Electricity .	½d. per unit	6,824	100%	4,290 B.Th.U.	4,290 B.Th.U	0·629d.	0·629d.	0·629d.	1·83

* Results obtained in practice over similar periods.

TABLE NO. 4 (*Test No. 3*).—*St. Mary's School.*

[Test Period Sept. 29—Dec. 15, 1932.]

1 Fuel.	2 Fuel Costs.	3 Gross B.Th.U. per 1d.	4 Boiler Efficiency.	5 Net Heat Output of Boiler per 1,000 C.Ft. Space per Hour of Occupancy.	6 Heat Input to Boiler per 1,000 C.Ft. Space per Hour of Occupancy.	7 Cost of Net Heat Output from Boiler.	8 Cost of Heat Input to Boiler.	9 Gross Cost of Heat Input to Boiler, including Labour Charges.	10 Ratio. Gas = 1.
Gas* . .	6d. per therm	16,666	79%	1,750 B.Th.U.	2,220 B.Th.U.	0·105d.	0·133d.	0·14d.	1·0
Coke* . .	30s. per ton	77,780	55%	6,369 B.Th.U.	11,580 B.Th.U.	0·082d.	0·15d.	0·201d.	1·43
Oil . . .	105s. per ton	32,000	65%	1,925 B.Th.U.	2,961 B.Th.U.	0·06d.	0·093d.	0·097d.	0·69
Electricity .	½d. per unit	6,824	100%	1,750 B.Th.U.	1,750 B.Th.U.	0·257d.	0·257d.	0·257d.	1·83

* Results obtained in practice over similar periods.

TABLE No. 5 (*Test No. 4*).—*St. John's Church.*

[Test Period Nov. 1, 1932—April 2, 1933.]

1 Fuel.	2 Fuel Costs.	3 Gross B.Th.U. per 1d.	4 Boiler Efficiency.	5 Net Heat Output of Boiler per 1,000 C.Ft. Space per Hour of Occupancy.	6 Heat Input to Boiler per 1,000 C.Ft. Space per Hour of Occupancy.	7 Cost of Net Heat Output from Boiler.	8 Cost of Heat Input to Boiler.	9 Gross Cost of Heat Input to Boiler, including Labour.	10 Ratio. Gas = 1.
Gas* . .	6d. per therm	16,660	84%	3,280 B.Th.U.	3,890 B.Th.U.	0·196d.	0·234d.	0·24d.	1·0
Coke* . .	30s. per ton	77,780	55%	3,860 B.Th.U.	7,070 B.Th.U.	0·05d.	0·09d.	0·12d.	0·5
Oil . . .	105s. per ton	32,000	65%	3,580 B.Th.U.	5,510 B.Th.U.	0·112d.	0·172d.	0·2d.	0·83
Electricity .	½d. per unit	6,824	100%	3,260 B.Th.U.	3,260 B.Th.U.	0·48d.	0·48d.	0·48d.	2·0

* Results for gas and coke are obtained from practical tests.

TABLE No. 6.—*Summary of Results Obtained from the 4 Tests*

Test No.	1	2	3	4
Type of Building	Library.	School.	School.	Church.
Method of Use	Continuous-Intermittent.	Continuous-Intermittent.	Continuous-Intermittent.	Intermittent.
Theoretical heat required per 1,000 c.ft. space per hour of occupancy	1,695 B.Th.U.	1,183 B.Th.U.	1,183 B.Th.U.	779 B.Th.U.
Net heat output per 1,000 c.ft. space per hour of occupancy	2,060 B.Th.U.	4,290 B.Th.U.	1,750 B.Th.U.	3 260 B.Th.U.
Boiler efficiency	78·0%	79·0%	79·0%	84·0%
Heat input to boiler per 1,000 c ft. space per hour of occupancy	2,650 B.Th.U.	5,450 B.Th.U.	2,220 B.Th.U.	3,890 B.Th.U.
Radiation per sq.ft. heating surface per hour of occupancy	106 B.Th.U.	406 B.Th.U.	162 B.Th.U.	237 P.Th.U.
Occupation efficiency—gas	82·0%	26·5%	65·5%	24 0%
Occupation efficiency—coke	60·0%	18·5%	18·0%	19·0%
Diversity factor	0·7	1·34	..	1·9
Cost of net heat—				
At 4d. per therm	0·08d.	0·17d.	0·07d.	0·13d.
At 6d. ,,	0·12d.	0·26d.	0·10½d.	0·196d.
Cost of gross heat—				
At 4d. per therm	0·11d.	0·22d.	0·088d.	0·156d.
At 6d. ,,	0·165d.	0·33d.	0·133d.	0·234d.
Ratio—Library = 1	1	2	0·8	1·4

COMPARATIVE COSTS OF VARIOUS FUELS.

METHODS ADOPTED FOR DETERMINING THE GROSS COST OF CENTRAL HEATING.

To arrive at a correct figure for the total cost of central heating it is necessary to take into consideration certain factors such as efficiency of heat control and labour charges. These are variables depending upon the type of fuel used.

Gas.

A. H. Barker estimates that about 5% excess heat is supplied by a gas boiler, simply due to the time lag of the temperature control and its inability to respond immediately to the changing temperature conditions in the building. This figure is, of course, incorporated in the practical results obtained on test.

It is also estimated that the labour charges involved in the use of a gas-fired boiler are roughly equivalent to about 5% of the total cost of the fuel.

Coke.

For a solid fuel boiler allowance must be made when comparing with a gas-fired boiler for the extra heat losses entailed in over-heating. A coke boiler on which the control, if any, is crude, will burn on the average 25% more fuel daily than the weather conditions necessitate, or 20% more than the heat output of gas, simply because it is not possible to reduce the rate of fuel consumption just when required.

Moreover, when buildings are in daily continuous use it is usual to bank up the fire overnight. During banking up periods it is estimated that the hourly rate of fuel consumption is about one-fifth full rate, and the only advantage, so far as heat is concerned, accruing from its continuous use is that only half the usual heat required for boosting up the temperature next morning is necessary. A. H. Barker estimates that in heating up from cold each morning a four hours full rate heat output is required to restore an adequate temperature in the building.

For ultimate comparison with the competitive fuels it is necessary to include the cost of labour for stoking, cleaning, and storage of solid fuel. In the case of coke this charge is far in excess of that required for oil or gas. It is estimated that the cost of labour is equivalent to about 35% of the total cost of fuel consumed.

Oil.

Two corrections must be made to the heating figures obtained for gas-firing in order to compare correctly with oil. First, the output of excess heat due to inefficient thermostatic control and heat losses in brickwork of the boiler when shut down amount to about 10% more than the equivalent losses for gas.

In the case of oil the labour charges are less than for coke, but due to the complexity of the burner apparatus, need far more frequent burner adjustment and minor repairs and supervision of fuel storage; this cost is estimated to be about 20% of the total fuel cost.

Electricity.

Local electric heating has no labour charges or uncontrollable excess heat, and may therefore be calculated direct from the figures obtained for gas heating.

Discussion.

Mr. J. H. DYDE, M.Sc. (Plymouth), proposed a vote of thanks to Mr. Sullivan, and said how proud they were at Plymouth to have the only Gas Supply Diploma man of that year's Institution of Gas Engineers' Examinations. He thought one advantage of considering a central heating job was that a more accurate estimate could be made of the cost of heating any building. Competition with other fuels was very difficult, and corporation undertakings found it easier to get this class of business than private companies.

Mr. S. B. JONES (Clevedon) supported the vote of thanks.

Mr. JAMES TAYLOR (Engineer and Manager, Weston-super-Mare) congratulated Mr. Sullivan on his Diploma success. At Weston the industrial load was practically *nil*, but he had hopes that in the near future there would be improvements with suitable price adjustments.

Mr. W. ATKINS (Bath) mentioned that they had obtained several large central heating installations in their area recently, and that these had all been obtained in the face of very keen competition from other fuels. He asked whether Mr. Sullivan agreed with the figure 100 therms of gas = 1 ton of coke for approximate calculation purposes; and stated that in one particular installation they had obtained a figure as low as 85 therms of gas equalling 1 ton of coke.

Mr. S. LLOYD (Weston-super-Mare) asked the author's opinion

of high-pressure central heating system using small pipes and rapid circulation; he favoured this system himself.

Mr. K. L. CLARKE (Hon. Secretary, Weston-super-Mare) asked what experience the author had of remote control thermostats coupled to central heating apparatus.

Mr. E. S. DAVIES (Bristol) said that several installations had been fitted in Bristol, though the price quoted was not as low as 4d. per therm. The orders were obtained chiefly because of the ease of control.

Mr. F. G. O'NIELL (Bristol) said he had experience of thermostatic control on central air heaters, and these were quite satisfactory.

Mr. SULLIVAN, replying, said that since he had been at Plymouth he had realized it was more difficult to get this type of order than when working for a corporation. One did not expect to obtain orders every day, but when they secured them they were well worth having. In his opinion the pressure central heating was going out of favour. The high temperatures at the radiator made them unsuitable for public buildings. In using thermostatic control some difficulty had been experienced with the bypass being put out by the draught from the flue, and there was some difficulty in fixing the relay points in public buildings. He thought the figure mentioned by Mr. Atkins for comparative heat values of gas and coke was fair.

Gas Meter Repairing and Testing at Swansea

A Paper read before the Wales and Monmouthshire Junior Association at Swansea on Nov. 24, following a visit to the new Guildhall.

By F. STUART JOHNS, of the Swansea Gas Light Company

The Swansea Gas Light Company have recently enlarged and extended the meter repair shop, whereby they can deal more adequately and extensively with the repair of meters.

While the meter department or its efficiency does not receive the publicity that many other departments of a gas undertaking get, it is nevertheless obviously a necessary and important one, and one that can prove most costly if it does not function properly.

My remarks will be confined to dry meters of the smaller sizes working at low pressures—*i.e.*, those in common use for domestic and similar supplies.

Efficiency and accuracy are first essentials, and in order to ensure that the meters out on the district are kept up to a standard state of efficiency, it is not advisable to allow them to remain in use longer than a given number of years, although views differ considerably as to what amounts to a useful life or duty without being brought in for examination. Ten years has been the time adopted for changing them by my Company.

With the development of the meter from the "light" type to the standard, and the advent of the high-capacity meter, the types of meter on the market are many and varied. While we recognize and appreciate that the increased throughput of these modern meters has been obtained without increasing their actual size—by developing the useful internal capacity and increasing the speed—it has led to a greater variety of sizes and shapes of meter cases for given capacities. It would be of considerable benefit to the Gas Industry if this number could be reduced and an agreement reached by the various undertakings, resulting in decreased costs of manufacture and reduction in the stock of meters and spare parts it is necessary to carry.

The replacement of meters on the district would be considerably simplified and cause less irritation to consumers if the meters could be exchanged in a few minutes without any adjustment of inlet or outlet connections or the meter shelf, which adjustments have invariably to be carried out —often at a time inconvenient to the householder.

Meter Repairs.

It has been proved that it is a most profitable business for an undertaking repairing, say, over 1,000 meters per annum to carry out such work by its own workmen. In the first place, it is necessary that the workshop should be dry, well ventilated, and spacious. The tools and plant required are not very costly, and consist of: Test holders, pressure gauges, bending machine, tinman's cutters, soldering stoves, and a few small tinsmith's tools, such as soldering irons, &c.

With regard to the former, the Board of Trade Gas Meter Testing Regulations of 1920 clearly state the method of calibrating from time to time. Therefore, it is necessary that the apparatus installed should be in perfect working order. We find at Swansea that the best method to adopt in regard to actual repairs is for each repairer to proceed with six meters simultaneously, in the following manner:

1. Remove all tops of the meters, inspect all working parts, and see that nothing is broken or stuck. A careful look out must be kept for sticky valves.
2. Remove all backs and fronts, and thoroughly wash out meters with paraffin. Afterwards test the leathers for soundness, and if there are any leaks in them, strip them out.
3. Re-tin all edges, and clean off old soldering ready for fresh soldering.
4. Fix new leathers, if required, and test for soundness at 5 in. pressure.
5. Solder on tee pieces to the discs, and try for free action. Then solder on backs and fronts.
6. Dismantle and clean all the fittings in the upper chamber. Clean and polish the valves, taking great care when re-setting, re-stuff all stuffing boxes, solder on valve box covers, and set index at zero.

The meters are now ready for testing.

Testing.

In the first place the soundness of the meter case must be tested. This is carried out at a pressure of 10 in., to ensure absolute soundness. After this has been done, the meter is tested for passing unregistered gas by the "float of lights" method, or perhaps better known as the "burning off test."

We will assume that the meter under test is a 5-light badged to pass 0·166 c.ft. per revolution, and 30 c.ft. per hour. The meter outlet should be checked down to deliver 30 c.ft. per hour, at a holder pressure of 20 tenths, by a suitably nippled cone, this cone being attached to a King's pressure gauge, which will denote the loss of pressure and steadiness in the water.

Set the index finger of the meter at a convenient starting point. Next, fill the test holder and set at zero (which is in the full position), then pass 2 c.ft. of gas through the meter as shown by the test dial. Shut off the holder, take the reading, and by simple proportion the percentage of error can be calculated. If the result is outside the limits of the statutory provision—viz., 2% fast or 3% slow—alteration of the crank or tangent must be made to bring the meter within the required limits. The meter should also be tested at open outlet, so that it will register correctly for all consumptions. The testing having been carried out, the tops and seal rings can be soldered on ready for despatch to the Official Testing Station.

The testing of slot meters is carried out in a similar manner, the attachment being tested separately by the "burning off test." Care must be taken to see that the valves are open to their full extent, because failure to do this might result in the rejection of meters for absorbing too much pressure. The Testing Officials do not test the attachments, so that when the meters have been stamped and returned, the attachment should be overhauled and set to pass the required quantity of gas for each coin. Before the meters leave the testing shop they should be corked or capped, both at the inlet and outlet, so as to prevent the entry of dirt, water, or air.

Converting Meters.

Most undertakings are doing away with 3-light meters. Does this mean that they have no further use for them? This need not be so, as they can easily be converted to 5-light or No. 2 size, save scrapping and cost of new meters, and will give every satisfaction in working, except that at the higher gas throughput slightly more pressure is absorbed. Another small difference is that the index of the majority of No. 2 size meters have 4 dials, whereas the 3-light meter has three dials only. The following results

show the excellent working of a converted meter, done in our own workshop:

3-Light Converted.			No. 2 Standard.		
Inlet Pressure.	Outlet Pressure.	Amount of Gas Passed per Hour.	Inlet Pressure.	Outlet Pressure.	Amount of Gas Passed per Hour.
Tenths.	Tenths.	C.Ft.	Tenths.	Tenths.	C.Ft.
20	17½	30	20	18	30
20	16	60	20	17	60
30	26	60	30	27	60
40	33	66	40	35	66
50	43	72	50	45	72
Open outlet passes 120 c.ft at 20 tenths.			Open outlet passes 170 c.ft. at 20 tenths.		

Prepayment Meters.

In addition to the well known "penny-in-the-slot" and "shilling-in-the-slot," there are several types which can be termed "combination" meters, such as the "Du Coin"—which can take either a penny or a shilling—and the "Du Slot"—which can take both penny and shilling.

The "Du Coin" is one of the latest developments in the interchangeable type of coin meter, one operation only being necessary to make the change; and since the removal of the attachment housing is not necessary, the collector can easily change it over from a penny to a shilling, or *vice-versa*, at the consumer's request.

With the old type, the change-over was more complicated, and in most cases it was made in three operations:

1. Removal and replacement of outer box.
2. Gear change.
3. Pocket change.

When changing-over was carried out by a collector or fitter, one important point had to be carefully watched—viz., if either of the two latter operations were omitted, serious results would follow, *e.g.*, a consumer might have a pennyworth of gas for a shilling, or *vice-versa*, resulting in much trouble and dissatisfaction.

The "Du Slot" meter appeals to some consumers whose requirements fluctuate from day to day. For instance, on a Sunday, when generally the cooking load is greater, the consumer is afforded the convenience of placing a shilling in the meter instead of having to insert twelve pennies for an equivalent amount of gas. It must be remembered that this also helps the undertaking, in that the meter box does not get full so quickly, and consequently requires emptying less often. In passing, it should be mentioned that if a shilling is placed in the penny slot, it is automatically expelled, so that no trouble is experienced as a result of such mistakes being made.

Attachments for Meters.

One attachment made by the Coin Change Company, Ltd., works a kind of coin exchange. This attachment can be fixed to the cash boxes of coin meters for pennies only. If a consumer desires change, he places a shilling in a slot provided for the same, and in return he receives twelve pennies as change. Whether or not this is a paying proposition must be left to the discretion of each individual undertaking.

Day and Night Attachment.

This enables the undertaking to make different charges during the 24 hours. For instance, one price for gas from 6 a.m. to 6 p.m., and a cheaper rate from 6 p.m. to 6 a.m.

The principle of this meter is very simple. There are two separate dials, one for day and the other for the night, which enable easy calculations of charges. A clock is fitted to the attachment, this clock being similar to the clockwork controllers on street lamps. It is wound up and set at a certain hour, at which time the gearing changes from the day to the night dial, and at a later hour the reverse action takes place. This is a great advantage to consumers, but the question arises whether they will take it too far, by leaving the work for which gas is necessary until the cheap rate operates?

Iron Arc Meters.

This type of meter is for use where special strength is required. It is constructed without solder, and is very easy to repair, the casing being in three sections—the lower body, the valve plate, and the valve chamber.

Therm Attachment.

This attachment is used for converting cubic feet registered to therms, and saves calculations and the use of conversion factors. It is quite a simple piece of apparatus, the index being the same, with additional wheels geared into it, to convert the amount of gas passed into therms. If the calorific value of an undertaking is changed, all these meters would have to be brought to the works, because to adjust them you have first to remove the tops. Consequently, the official seal would be broken, and it would be necessary to have them re-stamped, which would prove an expensive item.

The position in which a meter is fixed is well worth considering. Often meters are fixed in unsuitable places, such as damp outhouses, beneath sinks, and in cellars, &c., causing much inconvenience to the meter reader and to the consumer, as well as being detrimental to the life of the meter.

More harm still is incurred to meters which are left fixed, but unused. The valves are inclined to stick, which in turn will strain the flag arms and valve arms when gas is again passed through the meter. Also, the air which works back into the meter causes deterioration of the leathers. The practice adopted by my Company is to allow the meter to remain fixed for six weeks after the vacating of the premises. At the end of that period, if the meter is still unused, it is disconnected and brought to the works, a post-card being left at the point where it was fixed. This postcard is worded so that if the new tenant desires to avail himself of a supply of gas, he merely has to sign the card and forward it to the Company.

Unaccounted-for Gas.

In Swansea we have for some time past given this point serious thought. In the first place, it was decided to exchange meters which had been on the district for a period of over twenty years; secondly, to deal similarly with meters of fifteen years or over; and, latterly, to exchange those meters which had given service for ten years or over. All these meters were brought into the works, repaired, tested, and some converted. I think the following figures will be of interest.

—	Total.	Correct.	Working Fast.	Working Slow.	Stopped
Meters 10 years old and under 15 years . . .	1,172	408	91	641	32
Meters 15 years old and under 20 years . . .	284	50	4	206	24
Meters 20 years old and over	299	42	13	231	13
Total.	1,755	500	108	1,078	69
	..	28·5%	6·15%	61·42%	3·93%

It has been estimated that as a result of these exchanges the unaccounted-for gas should be reduced by approximately 2½ million c.ft. per annum.

It is apparent from the results of the tests that many of the meters now exchanged by the Company voluntarily would very shortly have to be exchanged compulsorily.

As stated, it has been decided to bring in every meter that has given ten years' service, for the purpose of testing in our repair shops. This should ultimately result in a large reduction in our unaccounted-for gas, and consequently a substantial reduction in our working costs.

Among those present who took part in the discussion and in expressions of appreciation of the paper were: Mr. W. H. Johns, Mr. E. Ablett, Mr. I. G. Jenkins, Mr. W. E. Crowley, Mr. J. H. Canning, Jnr., Mr. A. E. Pask, Mr. C. Collins, Mr. H. V. Williams, Mr. Hearson, Mr. Cuniffe, and Mr. R. S. Snelling, the Hon. Secretary.

Mr. Cuniffe spoke on internal corrosion and suggested using stainless steel for meter cases, while Mr. Crowley asked why there was such a high percentage of slow meters. Mr. Brett said that he had experienced trouble with sticky valves, and asked if Swansea had any trouble in this way.

Mr. Moore asked what effect the oil deposited in the meter would have upon it, and agreed that meters should be fixed in dry places where the temperature did not vary much.

The Author, in the course of his reply, agreed that the meter casing would be stronger if made of stainless steel, but said that the meters would be more expensive in the first place. The high percentage of slow meters was due to most of them being made of war-time material. The 2½ million c.ft. was not based on the total output, but on the slow meters, an estimated amount for each consumer, the stopped meters not being taken into account, so this figure was probably much higher. Very little trouble with sticky valves had been experienced in Swansea. The diaphragm leathers used in the repair shop at Swansea were already prepared for use when received, but in some places the leathers were treated with an oil free from acids, almond oil as a rule, mixed with graphite, being used. The oil in the meter tended to make it register slow.

The Design of Gas-Fired Water Heaters

With Special Reference to Heat Transfer

A Paper read before the London and Southern District Junior Gas Association, Nov. 23, 1934.

By T. G. NOBLE, B.A. (Oxon.), A.M.I.H.V.E., of the Gas Light and Coke Company

(*Continued from p. 765.*)

Practical Illustration.

A form of baffle designed to make the most of both features—*i.e.*, maximum local turbulence with high surface velocity—is shown in Fig. 6 (see B.P. No. 361,329). It will be noticed that the corrugations are of increasing amplitude to correspond with diminishing volume of gas, while the free path at any point A is designed to be insufficient for the volume of gas trying to pass, some of which is thus compelled to pass through the holes B, thereby creating turbulence. This effect has been observed[19] in water flow models using aluminium powder as an indication of the fluid movement. The analogy is not complete, since water is an inelastic fluid, but the method is of possible interest in studying other forms of baffle.

FIG. 6.

Other applications of the same principle are described in the patent referred to and have been embodied in well-known domestic water heaters.

Need for Further Data.

On the whole, however, much remains to be learnt about the application of the theoretical principles to practice. There appears to be little relevant published data. Those interested may be referred to Schack's book[20] (p. 276) in which data for forced convection are discussed—more particularly from the point of view of the economic balance between increased cost of power with baffled tubes and increased heat transmission. The conclusion is there reached that a high velocity in unbaffled tubes is generally more economical than a lower velocity in baffled tubes since the resistance increases much more rapidly than the heat transmission (see also [21], [22]). Similar conclusions, however, do not quite apply to constrained-convection in gas appliances, where resistance is important in relation to combustion rather than to economics, and where the possibilities of merely increasing velocity are limited by the natural draught available.

With both forced convection and constrained-convection, suitable baffles (pips, &c., as above discussed) on the heating surface are usually more effective, as would be expected (*cf.* [20] p. 283); but practical considerations such as the relative difficulty and cost of adding such baffles on sheet-metal appliances and the advantages in ease of cleaning smooth surfaces as compared with baffled surfaces have led to a fairly general adoption of the alternative for domestic appliances. For such, present practice (with the proviso that greater simplicity could often be obtained) appears to be sound, but the future tendency may be anticipated to be in the other direction. Much will depend, however, on the increased use of non-condensing appliances, the extent to which the sulphur content of gas can be economically reduced, or the greater availability of reasonably cheap non-corroding materials.

Radiation.

General.

Heat transfer by radiation requires no material medium and appears at first to offer immediate advantages, especially since the laws of radiation from solids have long been accurately known. From a suitably shaped sufficiently hot surface any desired heat transmission (within very wide limits) can be obtained and all the difficulties discussed under the heading of convection removed; and in theory one has only to produce the hot surface, surround it by any convenient water-cooled surface, and there is one's water heater! That there is a snag somewhere is certain, or high-temperature radiant surfaces would have been generally used instead of being practically restricted to one or two water heaters and a fair number of conversion burners (*i.e.*, gas burners for use in boilers designed for other fuels). The snag is, of course, that met in the design of gas fires—namely, the difficulty of effecting a high percentage transfer of potential heat to the potentially hot surface. So far it has not proved possible to do this with an efficiency of much more than 60%, so that, at best, much of the total heat transfer must take place by other means. Since the radiants, refractory structures, burners, &c., required to give even so high an efficiency are relatively complicated (sometimes requiring forced air supply or compressed gas), it is generally not worth while using high-temperature radiation from solids as the basis of water heater design—except possibly for large plant such as central heating units, of which at least one example will be familiar. Even this has a large area for convected heat transfer also.

Radiation from Baffles.

I have above been referring only to radiation from surfaces (refractory, &c.) glowing visibly: there is inevitably a certain amount of heat transfer to the water-cooled surface from any hot solid in the flueways—*e.g.*, from baffles, The proportion of the total heat transfer due to this varies, but may easily be of the order of 5-10%, and in some appliances double these values. In checking over experimentally any calculations concerning a given design this must be borne in mind. I do not propose to discuss this at length, since full details are given in the books referred to ([19], [20], [21], [22]), and the principles are likely to be familiar to all.

Radiation: Flames and Gases (Theoretical).

I should like to consider briefly another factor to which due importance is still not always attached—namely, the radiation from flames and more especially hot gases. Prior to 1924 attempts at calculating heat transmission in plants of various types were very uncertain, the uncertainty being greater the higher the temperatures of the gases considered. The application of the equations for conversion led to calculated surface conductances of the order of 10 B.Th.U./sq. ft./hr./° F., while, in practice, surface conductances up to the order of 100 were observed. There were two possible explanations (apart from experimental and mathematical errors)—namely, that the convection equations were en-

tirely wrong or that some other source of heat transmission existed.

The former hypothesis was untenable, for, despite the approximate nature of many of the formulæ, all gave results of the right order in appropriate conditions. It was due to Schack[23] that the correct explanation was found in the latter hypothesis. Accounts of his work have been given by Schack himself and by others in the books already mentioned [19, 20, 21, 22]: it is of such outstanding interest both in itself and in its practical implications that I may, perhaps, be forgiven for outlining the main points here. The origin of Schack's work can be traced to the development by Planck in 1900 of equations giving accurately the distribution of the total radiation from a "black body" at any temperature among the various wavelengths forming the complete spectrum. Examination of the curves showing this distribution indicates that at temperatures up to 2,000° F. practically all the radiation lies in the range of wavelengths from 1 to 15μ—*i.e.*, in the invisible infra red region. Visible radiation (light), which lies in the region 0·4-0·8 μ, plays no important part in ordinary heat transfer calculations.* It is important to realize this in judging radiation from luminous and bunsen flames, since there is a tendency to assume that the former are necessarily radiating much more energy than the latter. Experimental figures[55] indicate that while increase in aeration usually reduces flame radiation, the decrease is not always great. The results obtained by various workers differ widely and are not always comparable, since flame radiation depends on a number of inter-related factors (*cf.* [22] p. 39). It is probable that in water heaters flame radiation may account for up to 15-20% of the total heat transfer; measurements on burners in free air give lower results, but the conditions are rather different inside the appliance.

In practice, totally "black" bodies are rarely met, but some substances may be regarded as "grey" over a wide temperature range—*i.e.*, their radiation at each wavelength is always a definite fraction of that emitted by a "black" body at the same wavelength and temperature. The calculation of heat emission from such is relatively simple, but there are others which are not even approximately "grey" but emit or absorb heat selectively—*i.e.*, over certain wavelength regions only. Moreover, the emissivities at various wavelengths may differ among themselves and further vary with temperature. Of these, CO_2 and water vapour are among the most important for our present purpose, absorbing and emitting strongly at certain wavelengths† and hardly at all at others. The radiation from these gases even in infinitely thick layers (when the radiation is most intense) is thus always less than the radiation from a "black" body at the same temperature, but is nevertheless sufficient to account for a large proportion of the observed heat transmission in many appliances.

The total radiation from any gas is the sum of the individual radiations at the various radiating wavelengths. With increases in temperature this total increases, but, expressed as a percentage of "black" body radiation, it falls —*i.e.*, its intensity does not increase with T^4 (where T = absolute temperature) as does that of a "black" body.

The ratio $\frac{\text{gas radiation}}{\text{"black" body radiation}}$ thus varies with temperature and is, moreover, different from each wavelength.

It should further be remembered that while it is usual, in calculating the total radiation from CO_2 and H_2O in flue gases, merely to add the calculated individual radiations from these two substances, strictly it is necessary to correct for the slight but appreciable reduction due to mutual absorption of CO_2 and H_2O radiation (*cf.* [20, 16]). A further difficulty which, so far as I am aware, remains unsolved is that of correcting for the absorption of radiation from a hot gas core by the colder layers near the heating surface, though approximate corrections have been proposed (*cf.*, for example, [20] p. 196). It will be realized that the calculation of the total radiation from an infinitely thick layer of gas is a complicated matter and in practice the difficulty is increased by the fact that corrections for the thickness, shape, &c., of the radiating gas have to be made and that the values of these corrections also vary with temperature.

The calculation of gas radiation depends ultimately on absorption measurements at various wavelengths and temperatures and not all the existing data on this are satisfactory. Taking all these facts into consideration, it is not altogether surprising that published curves such as those of Schack[19], Hottel[50], and TenBosch[51] do not agree exactly. At the present stage of knowledge the disagreement is of less significance than the essential agreement; but exact concordance between the results calculated on the basis of any of the above authorities' curves and those obtained by experiment on any design of heater is hardly to be expected. Personally, I regard calculations of gas radiation as of value in giving results of the right *order* and thus being potentially a very important guide in the early stages of the design of an appliance; but it has been claimed that with some appliances—and perhaps with longer experience than I have had—more than this can be achieved (*cf.* Geck[16], Lubbock[52]).

The former paper is of especial interest to those concerned with the design of gas fired water heaters and merits most careful attention.

Radiation from Gases: Summary of Theoretical Conclusions.

Some of you may be wondering what all this has to do with design. I hope its relevance may be made clearer by the following generalizations based on the preceding remarks:

(1) Infra-red radiation from carbon dioxide and water vapour is a potential means of transferring heat in a simple manner.
(2) Under suitable conditions, it may account for as much as 90% of the total heat transfer, while in a water heater it may well account for some 50%.
(3) The amount of heat so transferred increases with
  (*a*) temperature of radiating gases. The increase is rapid though less so than that of a "black" body;
  (*b*) thickness of gas layer;
  (*c*) concentration or partial pressure of radiating gases.
(4) The amount of heat so transferred can be calculated, at least approximately, for many gas shapes, sizes, temperatures, &c.

Radiation from Gases: Practical Implications.

From this may reasonably be deduced the following practical points:

(1) In considering heat transfer in a new design, the first point to consider is to what extent one is going to design for gas radiation or convection—or both. It would appear foolish to reject without consideration the advantages of radiant transfer by building surfaces designed for convection immediately above the burner if this can be avoided. With luminous burners more particularly, it is necessary to have a fairly large combustion chamber to secure satisfactory combustion. It is in this region that the gases are hottest and the gas layers thickest. Thus, for quite other reasons than those given in this section, designers have, in fact, been led to build in a way favourable to heat transfer by gas radiation, but they have not always taken full advantage of the possibilities of extending the combustion chamber beyond the minimum essential to good combustion.
(2) It will be appreciated that the possibility of increasing gas radiation by increasing the concentration or partial pressure of the radiating gas is limited by the need to maintain a margin of safety on combustion. An appliance cannot work at a CO_2 percentage much above 9% CO_2, if it is to stand a gas pressure overload of 100%, on a gas having an ultimate CO_2 of 12·5%.
(3) Although at high temperatures and with thick layers of gas, infra-red gas radiation may be the most important factor in the total heat transfer, at low temperatures it is much less effective, and with thin layers of gas becomes negligible. Thus, if high efficiency is to be obtained with a reasonably compact appliance, radiation cannot be allowed to be the sole means of heat transfer;* convecting surfaces of maximum efficiency must be introduced during the later stage of the flue gas travel. These may be designed in various ways, the governing principles being those previously discussed.

Design for Gas Radiation: Practical Limitations.

It is hardly possible to be definite in recommending an optimum ratio of radiation to convection for all appliances, though once the general design† of any particular water heater has been settled it is possible by calculation to

* Although at the temperature on the surface of the sun (some 11,000° F.) nearly half the total energy is transmitted by visible light radiation.

† Chief CO_2 bands 2·36–3·02μ, 4·01–4·80μ, 12·5–16·5μ.
,, H_2O ,, 2·24–3·27μ, 4·8–8·5μ, 12-25μ or more.

* Some slight convection component is, of course inevitable, but if high flue exit temperatures were allowable its effect could be made negligible in comparison with that of radiation.

† this being governed by factors other than those now being considered, such as purpose of appliance, type of plant available or necessary for a given construction, cost of construction, &c.

arrive approximately at such a ratio. Geck[16] recommends aiming at such a distribution of the total heat transfer that some 50% is by radiation and 50% by convection, and for appliances such as non-storage heaters and central heating units this appears to be reasonable. I doubt its general validity, however. For example, in designing a wash-boiler of high efficiency but low price we have felt compelled to adhere largely to present practice and obtain good results by modification of the burner to give a more intense local heat transfer rather than design for gas radiation, though the principle of increasing convection transfer over the later part of the flue gas travel by the addition of fins has been adopted. In such an appliance the main shape of the heating surface is decided by the practical requirement of having a pan of a material and shape not too unfamiliar to the housewife and suitable for the various uses to which she may put it, very easily cleaned, and of a capital cost not unreasonably high in relation to any economies effected in running costs. Somewhat similar considerations apply to other domestic utensils, such as kettles and saucepans, in which water has to be heated and which may therefore be considered as coming within the scope of this paper, and to larger appliances, such as industrial water and steam baths and restaurant fittings (food boilers and steamers, &c.).

I hope I have said enough to indicate that the advantages of gas radiation as a means of heat transfer must sometimes remain theoretical. The theory is nevertheless of real practical importance and must be taken into account if only to be rejected for a given practical purpose. In the complete theory of the design of water heaters, gas radiation is only one of many factors which have to be taken into consideration. Some of these have been considered in the earlier sections of this paper; others, of a type more commonly referred to as "practical" have been indicated in my remarks on wash-boilers, &c., in the preceding paragraph. A complete theory of design would enable one to decide beyond doubt and without experiment the relative importance of the many factors involved. Such a theory is unattained, if not unattainable, and meanwhile practical demands are urgent and keen competition has to be met. I am convinced that no industry that wishes to live can afford to ignore even the most academic contributions to scientific knowledge. Only after due consideration dare it assert that no immediate application can be found for a particular piece of work. Even a cursory examination of the published work will convince anyone who is in doubt that this assertion cannot be made of the theory of gas radiation.

Condensation.

I have so far almost entirely ignored the effects of condensation, although heat transfer by convection and conduction are both involved, mainly because the theoretical considerations are less certain and more complicated than those hitherto considered, and I am less confident of the possibility of applying them to the design of water heaters. Without discussing further the merits of condensing as compared with non-condensing appliances, I assume that for some time the former will continue to be designed, and one should therefore examine the possibility of designing them scientifically. The results of a survey are far from encouraging. The relevant published information is not very extensive and is mainly concerned with saturated vapours, of which steam has been most fully investigated for obvious reasons. The presence of air or other gas modifies the conditions appreciably, and no final conclusions concerning mixtures such as occur in flue gases appear to have been reached.

Nusselt[53], in 1916, first developed a mathematical treatment of the problem on the assumption of streamline flow of the condensed vapour—*i.e.*, zero velocity at the solid surface, and discussed the many factors affecting the thickness of the condensed film and the resulting heat transfer. More recently others[54] have extended his ideas to mixtures of vapour and gas, but the results are not immediately applicable to gas appliances, nor is such application likely to be possible in the near future, as consideration of the effects of the state of the cooling surface alone will show. Experience or experiment remain the main sources of information when this aspect of design is being considered, but theory can be a useful guide in the way indicated below. The actual dew point of the flue gases of most water heaters is of the order of 130°-140° F., depending on the amount of water vapour and excess air present. It is usually calculated from a knowledge of the percentage of carbon dioxide in the flue gases and of the gas characteristics. The values so determined may be low, as it has been shown[55] that the presence of sulphur oxides appreciably raises the dew point. Single layer metal walls in water heaters may be below this temperature, since, as we have seen, the temperature difference through such walls is very slight. Means of increasing this difference so as to avoid condensation have been previously mentioned and other methods are in use. Where condensation is desired surfaces permanently at temperatures below the dew point of the flue gases must be provided—normally by taking no special precautions to avoid them—and maximum heat transfer by the methods already discussed must be aimed at the most favourable condition for heavy condensation being thus automatically obtained.

It should be noted that my earlier remarks on the controlling effect of h_g do not necessarily apply to appliances in which condensation takes place freely (as distinct from the many in which initial or slight condensation only occurs). Surface conductances under condensing conditions are high (of the order of 1,000 B.Th.U./sq. ft./hr./° F.), and thin deposits on the heating surfaces (corrosion) or waterways (scale) may therefore have a considerable effect. In appliances used for boiling water (steam raising boilers, café appliances, stills, &c.) the more violent motion of the water increases the surface conductance on the water side, but, unless condensation is heavy, the gas film remains the controlling factor until thick layers of scale have formed. These conditions must be carefully distinguished from those found in heat exchangers, evaporators, or baths heated by condensing steam, where surface conductances on both steam and liquid sides are high, and a thin layer of scale or rust has a marked effect on the overall conductance.

In concluding this section, I would draw your attention to the possibility of securing high efficiencies together with hot dry flue gases by bringing about a maximum of condensation in the appliance and passing cooled saturated gas over some heat exchanger, whereby the flue gases are re-warmed and become unsaturated. With such an appliance efficiencies of over 90% are theoretically obtainable without the disadvantages of low flue temperature usually associated with such high efficiencies (*cf.* B.P. No. 360,893).

General Considerations on Design in Relation to Heat Transfer.

By-Pass Efficiencies.

There is no difficulty in obtaining good thermal efficiencies at a given gas rate with most types of water heater if due attention is paid to the points discussed above. It is less easy to design a heater having high efficiency over a range of gas rates, more particularly at full normal rate and at by-pass rate, when under thermostatic control—*e.g.*, storage heater, central heating units, steam boilers, café boilers.

The difficulty is greater the less the ratio

$$\frac{\text{By-pass or maintenance rate}}{\text{Full gas rate.}}$$

For central heating units this is usually of the order of $\frac{1}{10}$, but with domestic and other storage heaters it may be less than half this if the full gas rate be high and the system well lagged. If the efficiency at full rate is of the order of 70-80%, the by-pass efficiency may be between 50% and 60%; the reduction is due mainly to the increased value of the amount of air passing through the flueways per c.ft. of gas burned, the corresponding decrease in CO_2 content and mean flue gas temperature, combined with reduced linear velocity of gases, leading to a lower percentage heat transfer by gas radiation and convection.

(*To be continued.*)

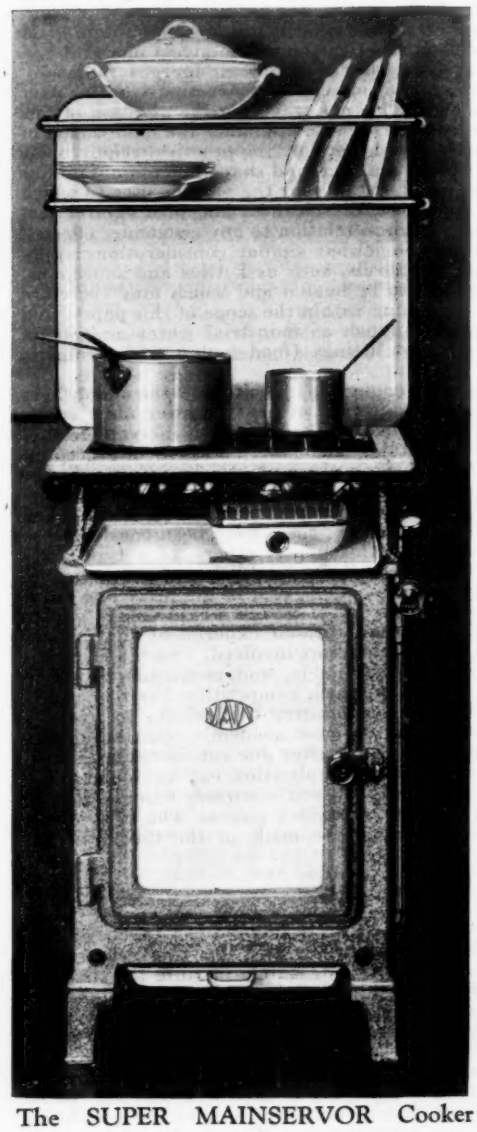
Gas-Workers' Strike at Neath.

On account of a dispute concerning a wage claim which had not the official support of the men's leaders, stokers and labourers of the Neath Corporation Gas Department stopped work at 6 a.m. on Sunday and, at the time of going to Press, we understand that the Works are being kept going by Mr. W. Clark Jackson, Engineer and Manager, with the assistance of officials who have volunteered for work.

It is understood that the Staff were prepared to assist in maintaining a supply as long as possible in view of the fact that the strike was unofficial. When the stokers finished work the holders were full, and Mr. Clark Jackson and his staff were hopeful of continuing a supply until a settlement could be reached. The amateur stokers consist, we learn, of clerks, collectors, meter readers, and fitters, who are reported to be working in relays. The local papers were able, at one time, to report that extremely rare occurrence—a "gas blackout." Owing to a mistake on the part of one of the staff in turning a wrong valve, there was for one moment no gas light, but the error was very quickly realized and remedied.

MAIN

GAS COOKERS



The SUPER MAINSERVOR Cooker

THERE are MAIN Cookers for all your requirements — from the simple hire cooker to the highest grade of cash selling appliance. These include stand types, floor types, and elevated ranges in standard black, self colours, or mottle and dapple enamels—with or without automatic control.

Catalogues for your Showrooms and folders for distribution to your consumers will gladly be sent on request

R. & A. MAIN, LTD.
LONDON AND FALKIRK

London Office and Showrooms:
48 Grosvenor Gardens, S.W. 1

Glasgow Office and Showrooms: 82 Gordon Street

A Technical Signpost to the "JOURNAL"

Covering items of outstanding technical interest during the July-September quarter of 1934.

Vol. 207, July to September, 1934

GENERAL.

The figures published in "Field's Analysis" for 1933 give a picture of the Industry which cannot be described as altogether satisfactory (p. 33). Reduced sales of gas are coupled with an increased number of consumers and consequently involve lower sales per consumer and per mile of main. Manufacturing costs have, however, been reduced and, in general, the net gas rental has not greatly altered. A similar trend is shown by the Board of Trade returns of authorized gas undertakings (p. 638). Thus, the total gas sold in 1933 is lower by about 0·3% than in 1932, and as the quantity made is greater by 0·07%, there is apparently a slight increase in gas unaccounted for. The total number of consumers has risen considerably—viz., by about 2·3% during the course of the year. The quantity of coke oven gas purchased by gas undertakings continues to increase; in 1932, the figure was 15,441 million c.ft. purchased by 32 undertakings, compared with 16,326 million c.ft. in 1933, purchased by only 31 undertakings; of this total the Sheffield Gas Company is easily the largest purchaser with 5,522 million c.ft.

The broad economics of the production of petrol from coal and some reflections upon the policy of subsidizing industries are given in a lecture by Prof. Bone (p. 34). He regards the production of petrol from coal by hydrogenation as the only process by which supplies large enough to be of national importance are likely to be obtained. It is pointed out, however, that the preference of 4d. per gallon on the 100,000 tons of petrol which are to be produced annually by the I.C.I. will involve an annual loss of £500,000; but on the other hand employment for some 1,500 miners will be found, representing a wage bill of about £200,000 per annum.

A general survey of the possibilities of the collection and distribution of gas in bulk has been presented at a recent meeting of the British Association (p. 658). It is stressed that costs of manufacture are not necessarily lower in a large works than in one of medium size—as is the case with electrical generating stations. Reduced costs may, however, be obtained by the cheaper purchase of coal, but against this must be debited the cost of transport of the coke to the area in which manufacture is replaced by gas sent from an adjacent undertaking. Up to a consumption of 5 million c.ft. per annum it is cheaper to convey gas and coke over distances up to 5 miles than to rail coal for gas-making. For quantities of the order of 25 million c.ft. the distance may be increased to 31 miles, and so on. It is interesting to note that complete gasification is less economical than the transport of coke and gas owing to the greater volume of gas of higher density and lower thermal value which must then be distributed. The potentialities of bulk distribution are discussed in relation to three areas each of which has distinctive features. For a greater London area it is suggested that there should be concentration of manufacture alongside the Thames and at suitable points some 20 miles north and south of the river. Development along these lines has already taken place to a considerable extent north of the river but only to a minor degree on the south. In the Sheffield area, future development lies in the distribution of coke oven gas by the Sheffield Gas Company. An area centering on Birmingham is suggested as being suitable for a local gas grid, manufacture being concentrated at the above town and at Wolverhampton, while a further area is represented by the country between Preston and Colne to the north and Stalybridge and Liverpool to the south. In this highly industrialized area there are numerous individual undertakings within a few miles of each other, and concentration of production at a few of these promises not inconsiderable economies.

Details of an interesting experiment in connection with the use of compressed gas is extracted from the report of H.M. Inspector of Explosives (p. 565). Two fully charged cylinders were placed over a rectangular tank containing wood and 100 gallons of petrol which was then ignited. A period of four minutes elapsed before the cylinders burst. In practice the cylinders are, of course, now fitted with fusible plugs to release the pressure before the bursting stress is attained in the metal. Some further costs in relation to the distribution of compressed gas in cylinders for domestic and other purposes have been given by Pignot (p. 416). These are based on the distribution of the cylinders by a gas-driven lorry working within a radius of 25 miles from the compressing station. Assuming the lorry to be always fully occupied, the overall transport costs are calculated to be 1s. 6d. per 1,000 c.ft. of gas. To this must be added the cost of compression (8·5d. per 1,000 c.ft.), the capital charges on the gas cylinders (0·3d.), and cost of inspection of consumers' fittings (1·2d.). The total cost is thus 2s. 4d. per 1,000 c.ft. This figure does not include the cost of the special fittings at a consumer's residence, which is given as about £10.

A plant for the pneumatic handling of coal has been put into operation by the York Gas Company (p. 99). Coal is picked up from barges by a 5-in. diameter suction pipe at the rate of 20 tons per hour, transported some 120 yards and then discharged into trucks, the necessary power being provided by a 50-H.P. pump. From the size of the suction pipe it may be presumed that only small coal can be handled.

An article on "Occupational Hazards in the Chemical Industry" contains an important reference to the dangers of inhaling hydrogen sulphide (p. 577). This gas can be detected by smell when present to the extent of only 10 parts per million, but the sense of smell is soon fatigued and the presence of the gas becomes unnoticeable. With some 150 parts per million in air, noticeable toxic symptoms are produced. The effect of inhaling this gas is often not felt until some hours later when the difficulty of breathing is rarely diagnosed correctly.

CARBONIZATION.

Several new installations of vertical retorts are reported. The carbonizing plant of the newly erected works of the Shanghai Gas Company (p. 103) consists of a bench of the 80-in. "W.-D." retorts with a total capacity of 4 million c.ft. per day, while the two waste-heat boilers provided are each capable of supplying the complete steam requirements of the works. At Neath, a bench of eight "W.-D." retorts has been installed with a capacity of 36 tons of coal per day equivalent to 753,000 c.ft. per day (p. 32). New installations of vertical retorts which are to be erected by the Woodall-Duckham Company range from a bench of 16 retorts of the 82-in. size at Liverpool to one of three retorts of the 44-in. size for the Burgess Hill and St. John's Common Gas Company (p. 304). In regard to the Glover-West type of vertical retort a new installation of 12 retorts has been put into operation at Worcester (p. 157). The retorts have a major axis of 50 in. and are heated by step-grate producers under natural draught.

An interesting account has been given of the conversion of intermittent vertical retorts to chamber ovens at the Devonport works of the Auckland (N.Z.) Gas Company (p. 315). The ovens which have been constructed are 13 ft. 2¼ in. long and 5 ft. 10½ in. by 13 in. in section, with a taper of ¼ in. per ft. in the sides and ⅛ in. per ft. in the ends. In addition, the walls are built convex outwards with a maximum camber of 1 in. The most interesting feature of the design is the provision of gas passages in the brickwork, through which the gas evolved from the bottom of the charge can be removed to the gas off-take pipe at the upper end of the retort. This arrangement eliminates the provision of bottom gas off-takes and, it is stated, has been found to be very successful in practice. As would be expected, it is necessary periodically to remove the carbon from the ducts, this being effected by opening the bottom door of the chamber and the top of the duct to the atmosphere. The current of air thus induced effectively burns out any carbon deposits. At present, a charge of 25 cwt. is carbonized in 18 hours, and the strongly coking slacks which are available locally have been treated without difficulty, no poking being required for the discharge of the coke. The ovens have now been in operation for two years, and no noticeable deterioration has been observed in the silica blocks and tiles with which the chambers are constructed.

In a paper presented to the recent International Gas

Conference at Zurich are outlined methods of testing various new carbonizing and purifying, &c., plants to ascertain whether these fulfill the guarantees given by the contractors (p. 519). The methods in question, which have been established for several years in Germany, are officially recommended by the German Gas Association and as such will repay careful study, particularly as there is no equivalent system in this country. With regard to carbonizing plant there are several items of note. Guarantees are to be based upon a specified thermal yield indicated by an assay test—and a specific test is given. The gas undertaking must indicate the density of the coal as charged and a margin of 5% is allowed in this item in the actual test. A deduction of 3% in the gas made and in the carbonizing period is allowed for each 1% moisture in the coal in excess of the agreed figure. The calorific value of the gas must be within 11 B.Th.U. of the stipulated value, but a margin of 5% is allowed in the gaseous thermal yield. Nitrogen *plus* carbon dioxide are limited to 12% and oxygen to 0·5%. Three alternative bases are given for guarantees of fuel consumption—*i.e.*, as dry ash-free coke, as B.Th.U. in coke, or as B.Th.U. in "cold" fuel gas per lb. of coal. The maximum allowance from the specified figure is again limited to 5%. The life of the refractory material may be guaranteed, allowance being made for each shut-down, provided that this is not enforced by faulty construction or operation.

PURIFICATION.

The position of the bye-product sulphate of ammonia industry is conveniently summarized in the report for 1933 of the Chief Alkali Inspector (p. 24). It is noted that while the higher price of sulphate (£7 per ton) allows profitable manufacture by only the larger undertakings, the smaller ones might with advantage consider the concentration of their liquor, since the concentrated liquor can often be sold at a profit even after allowing for the capital outlay involved in the concentration plant. Although a number of automatically controlled concentration plants are now in operation in the south of England and also in Scotland a large quantity of liquor is still being lost or destroyed in various ways. Consequently, the tonnage of ammonium products manufactured by gas-works expressed as sulphate of ammonia has again decreased from the previous year—*i.e.*, 89,500 tons in 1933, against 97,800 tons in 1932.

From Germany is reported a new and interesting method of sulphuric acid manufacture which is of particular interest to gas-works, in that the sulphur is provided by the foul gases leaving a sulphate of ammonia plant saturator (p. 26). These gases are burnt with air in a vertical firebrick furnace, giving a gas containing 3-8% of SO_2. This gas at a temperature of about 500° C. is then passed over a vanadium catalyst, where it is converted into sulphur trioxide. Finally the mixture of sulphur trioxide, steam, and inert gases pass to a cooler where concentrated sulphuric acid is produced. The novelty of the process lies in the fact that, whereas formerly it had always been considered necessary to dry the sulphur dioxide prior to its coming into contact with the catalyst—with the result that the sulphur trioxide formed could only be absorbed by washing with concentrated sulphuric acid in a series of large towers—in the new arrangement these are not required, and hence the plant is less expensive. A small experimental unit is said to be in operation at the Frankfurt Gas-Works.

A new process of hydrogen sulphide purification is proposed by the I.C.I. which, *inter alia*, has the advantage, or disadvantage, that an appreciable amount of ammonia is lost during its operation (p. 307). The basis of the method which is known as the "Auto" process, is the reaction between hydrogen sulphide and ferric ferrocyanide in the presence of ammonia thus:

$$Fe_4(Fe(CN)_6)_3 + 2H_2S + 4NH_3 = 2Fe_2Fe(CN)_6 + (NH_4)_4Fe(CN)_6 + 2S.$$

The ferrous salt is easily oxidized by air to reform the ferric salt, the ammonia being liberated. The initial ferrocyanide solution is obtained by washing crude gas with a dilute solution of ferrous sulphate, which absorbs hydrocyanic acid and ammonia forming ferrous ammonium ferrocyanide. The plant, therefore, consists of a scrubbing tower where the hydrogen sulphide is absorbed by the above solution and an aeration tower up which are passed both the liquid and the air for regeneration. The following are given as typical results:

	Inlet Scrubber.	Outlet Scrubber.
H_2S	700 grains/100 c.ft.	.. *Nil*–0·3 (pts /100,000)
HCN	25 ,, ,,	.. 0·10 grains/100 c.ft.
NH_3	170 ,, ,,	.. 60 ,, ,,

Under normal conditions the H_2S is completely removed from the gas, but with any choking or irregular liquor distribution in the scrubber some slip may occur. Owing to the presence of finely divided sulphur, freedom from choking cannot be guaranteed, and oxide catch boxes are necessary. The sulphur, which is recovered from the liquid by flotation, contains about 90% of pure sulphur. About 60% of the ammonia is removed from the gas and presumably lost in the air from the regenerator—the ultimate destination of this ammonia-air mixture is not, however, stated. The costs are similar to those obtained with oxide purification, excluding any allowance for removal of any traces of H_2S which may escape from the scrubber.

Rather remarkable results are claimed for the use of a mixture of "Lux" and granulated blast furnace slag as a purifying material (p. 262). By the use of this material the capacity of a set of purifiers was increased by 50%, and the sulphur absorbed per unit weight of Fe_2O_3 was increased by the same amount. The comparison is made with the oxide previously used, this being apparently a mixture of oxide (the character of which is not stated) and wood shavings. The disadvantages were (*a*) an increase of 25% in the back pressure and (*b*) the fact that much greater care was necessary in the operation of the boxes, the selection and mixing of the slag and oxide, &c. In explanation of the greater efficiency it is suggested that the lime present in the slag assists in the absorption of sulphur. It is unfortunate that more details of the oxide originally used are not given so that a more careful comparison can be obtained.

The determination of naphthalene in coal gas has been receiving some attention on the Continent. Two German investigators who have examined the picric acid method conclude that naphthalene is not completely absorbed if the temperature exceeds 10° C. The maintenance of a temperature of 4°-7° C. in the absorption vessels is hence recommended (p. 214). A new method, originating in France, consists in determining the weight of naphthalene required to saturate a sample of gas at a given temperature (p. 204). In view of the difficulty of obtaining complete saturation without super-saturation of the gas with naphthalene, this method does not suggest great accuracy.

An article has been contributed by Fulweiler on the cause and prevention of pilot light stoppages (p. 253). Examination of deposits from 1,000 stoppages showed 96·6% of these to contain vapour phase gums and 53% oxide of iron. Analyses of the deposits showed that inorganic material constituted about 2/3rds of the total, the remainder being mainly grease and fatty material. The actual proportion of vapour phase gum was only about 5%. The grease is regarded as being of extraneous origin, and the inorganic matter can be easily explained by corrosion of mains and service. To what extent the percentage of gum deposited from the gas is accountable for the segregation of the inorganic material is not clear, but it recommended that the nitric oxide be removed from the gas and the formation of vapour phase gums thus inhibited.

COKE.

Several items of interest are noted in the reports of the various Coke Research Committees.

The process which was developed by the Midland Coke Research Committee for improving the quality of coke by incorporating fusain with the coal or, in the absence of fusain, finely ground low-temperature coke, has been widely adopted and, in consequence, the Committee has now decided to make it freely available to all who wish to use it (p. 99). According to the Northern Coke Research Committee, experiments with an "Ideal" coke boiler have shown that several foundry cokes formed excellent fuels for this apparatus when suitably graded. Tests with different sizes indicated that the best results could be secured with the ½-1 in. size (p. 25).

A novel type of coke screen has been installed by the Woodall-Duckham Company at Neath (p. 32). This is known as the "Undulo" screen and consists of a number of perforated rubber sheets suspended from cross bars so as to form a series of hills and valleys. By a suitable mechanism the valleys are alternatively converted into ridges, which results in the coke being given a forward motion. The perforations are varied in size along the length of the screen, and the coke is thus separated into different sizes in its passage along the rubber sheets. The arrangement has obvious advantages in reduced breakages and increased life of the screens themselves.

Considerable interest has been evidenced in the methods which are being tried out in America to render the coke dust-proof, and in a recent report of the American Gas Association are summarized the investigations which have been taking place on this problem (p. 310). A variety of solutions have been examined as regards their suitability for spraying and "dust-proofing" of coke. Calcium chloride is a very effective material for this purpose, but the liberation of the chlorine on the combustion of the coke and subsequent corrosion which results is a serious drawback, and limits the utility of the coke so treated. Taking into consideration not only the dust-proofing efficiency but

also the price of the spraying material, the use of an aqueous emulsion of crude mineral oil is recommended, a solution of sodium resinate being employed as the emulsifying agent. The quantity of emulsion required is about 2 gallons of solution per ton of coke, this consisting of a one in ten emulsion of oil in water, to produce which about 1 lb. of sodium resinate is necessary. The experience of several undertakings which have been treating coke in this way, is that it has virtually eliminated the former complaints of dusty coke, while the treatment has not been in any way detrimental to the burning properties of the coke. Excessive addition of oil should be avoided, as this causes appreciable smoke formation when the coke is first ignited. The method employed for treating coke with the oil emulsion by the New York and Queens Gas Company is described in a separate paper (p. 366). The coke is discharged from the hoppers into trucks by means of chutes, and over each chute is fixed a spray nozzle which is pumpfed with oil-water emulsion. Details are also given of the preparation of the oil-water emulsion which is initially heated to a temperature of 200° F. but cooled to about 100° F. before spraying on to the coke.

A series of three articles have been contributed on the use of coke for heating (p. 259, &c.). Details are given of the types of boilers used for central heating and the essential points to be considered in their operation. Automatic control of the temperature can be easily arranged, which has an added advantage of often allowing considerable economy in fuel consumption. In the third article the general principles involved in the combustion of coke in an open grate are discussed.

TAR.

For some time it has been known that the use of coal tar oils for internal combustion engines was being examined experimentally in various quarters. Little definite information was, however, forthcoming, and it has been left to the Institution to investigate and summarize the present position. The majority of the report which has been issued on this question is concerned with the use of tar oils in the spark ignition engine (p. 642). After the initial experiments made by the Belfast Gas Department and the Omnibus Company a number of firms have investigated the possibility of using coal tar oils. In a few cases the results have been satisfactory. At Belfast, however, the Omnibus Company has reverted to petrol, and unsatisfactory reports are given by a number of other firms. The general conclusion is that "the attempt to popularize the use of coal tar oils has in large measure failed." It should, of course, be remembered that in all cases the experiments have been made with engines designed for petrol, but the results of the experiments would not appear to justify the labour and expense of designing an engine specifically for coal tar oils. It is interesting to note briefly the difficulties encountered in the use of tar oils. The evidence collected in the report is often contradictory, which is not surprising in view of the various types of engines employed and differing conditions of use. In regard to the composition of the tar oil, it is difficult to obtain a uniform and consistent product and an oil suitable for internal combustion engines requires considerable care in its manufacture. Differences in composition of the fuel probably account for many of the inconsistent results obtained. Exhaust gases when the engine is idling generally possess a creosote smell—for this reason experiments were abandoned in Manchester. Mineral lubricating oil is unsuitable owing to sludge formation, but castor oil appears to give good results. In a number of cases excessive oil dilution has been incurred. Experience in regard to mechanical troubles attributable to the use of coal tar oil is very variable. According to the Belfast Omnibus Company, there is considerably greater wear in certain parts of the engine. One of the main advantages of the use of coal tar oil is the possibility of increasing the compression ratio owing to the anti-knock character of the oil, but no advantage was taken of this property in the majority of the experiments with standard makes of engines. Satisfactory results are being obtained with stationary internal combustion engines using tar oils—but it should be remembered that conditions of work are here much less onerous. In regard to the Diesel engine, the low ignition temperature of tar oils is a serious disadvantage, and although experiments have shown that such oils can be used with suitable modification of the engine, their use has not been carried beyond the experimental stage.

The fact that for the manufacture of "Bitural"—a tar condensation product devised to replace bitumen for road surfacing purposes by the Melbourne Gas Company—a grease recovered by the Bradford Sewage Department is being used, has led to experiments in this country with a similar material (p. 99). On an experimental stretch of road this has given excellent results, and a further continuation of the tests is proposed.

STORAGE.

A spherical holder has been erected for the Ostend Gas Company and has a capacity of 706,000 c.ft. at six atmospheres pressure (p. 303). The overall diameter is 61½ ft., and the sphere is supported by three equally-spaced reinforced concrete piers.

In a paper on the servicing of gasholders, the general aspects of the relative merits of water-sealed and waterless holders are very clearly expounded (p. 370). The author—an official of the Consolidated Gas Company of New York—regards the majority of the objections to the new waterless type as unfounded, and evidences the fact that there are now 254 holders of this type in different parts of the world, which are working under extremes of high and low temperatures. The details given regarding the practice, presumably of the above Company, in regard to the supervision and maintenance of their holders is worthy of careful study and might with advantage be taken as a basis of operation by many undertakings.

Investigation of Atmospheric Pollution.

Conference of Local Authorities.

Thirty-two representatives of local authorities and other organizations co-operating with the Department of Scientific and Industrial Research in the investigation of atmospheric pollution met on Nov. 26 in the half-yearly conference at the offices of the Department. The gathering included representatives from London, Manchester, Glasgow, Liverpool, Southampton, Leicester, Newcastle, Hull, Scarborough, Halifax, Lancaster, Leamington, and Wolverhampton.

The Conference, over which Councillor W. Brownhill-Smith, of Glasgow, presided, received a report from Dr. G. M. B. Dobson, F.R.S., on the progress of the researches carried out under the Atmospheric Pollution Research Committee. Dr. Dobson stated that the new method which had been developed at the Building Research Station for estimating sulphur in the atmosphere was now being used at 27 stations. It was hoped that it would be adopted still more widely by local authorities, as it gave, with little expense, information of great value concerning one of the most destructive of atmospheric impurities. He also referred to trials which were being made of a photo-electric method for recording daylight.

Mr. Beaumont, of Halifax, suggested that there was much more that local authorities could do to provide information about the effects of atmospheric pollution. He instanced that in Halifax, side by side with the deposit gauges recording the highest and lowest deposits, apparatus was employed in order to give information with regard to the sunlight received at those points. A large amount of useful information had been gained in that way, showing that as compared with the less polluted station the other lost about 25% of sunlight during the year, the percentage loss being greater in winter than in summer.

Popularizing the Domestic Coke Fire.

Oldham's Enterprise.

Gratifying news reaches us from Oldham, where, for a considerable time past, the Gas Department have been concentrating on the installation of domestic grates suitable for burning gas coke.

Mr. Ernest Parry, the Commercial Manager of the Oldham Gas Department, whose announcement that over 800 coke grates had been ordered was recorded in last week's "JOURNAL," now tells us that during the past seven or eight weeks they have actually fixed close on two hundred such grates, while there are housing schemes already commenced which will take another 1,500.

On one estate of 900 houses, although for the first block of about 40 only one grate has been installed in each house, the next block of houses are to have two coke fires in each house. The Oldham Corporation are also to install coke grates in the next block of new property they are erecting to the number of 124 houses and 16 bungalows.

The Royton District Council, which is within their supply area, is also erecting 69 houses—the first instalment of a larger scheme—and in each of these houses a coke grate is being fitted. In the case of two other Authorities within the area of supply, serious consideration is being given to the installation of coke grates on housing estates shortly to be commenced.

It is felt that this is a sure method of solving the coke problem, while at the same time assisting in the smoke abatement campaign.

Claim for Loss of Cattle by Road-Tar Poisoning

An Action of importance to the Gas and Tar Industries.

A case was heard at the Castle, Leicester, on Nov. 28, 29, and 30 and Dec. 1, in which John Thompson, a dairy farmer, of Glebe Farm, Thurlaston, claimed £631 15s. from the Leicestershire County Council for loss of cattle which he alleged had been caused through water-supplies from which the cattle drank having been polluted by tar which had been sprayed on the surface of Enderby Lane, Thurlaston, by the Blaby Rural District Council, whose responsibilities as a highway authority had now been transferred to the County Council.

The case came before Judge J. W. McCarthy, a former County Court judge, sitting as arbitrator and special referee. The plaintiff was represented by Mr. Erskine Simes, and the County Council by Mr. C. B. Fenwick. Mr. P. G. Waller, solicitor, watched the case on behalf of the Midland Tar Distillers, Ltd., by whom the tar with which the road had been sprayed was supplied.

Counsel for the plaintiff stated that Enderby Lane passed between fields in which Mr. Thompson's cattle grazed, and nearby at the foot of a fall in the road stood the farm buildings, with foal yard, shallow wells, one of which was close to the road, on one side; while there were two cottages, with two wells, on the other side, where also there was a pond at the roadside. This pond was fed with surface-water from the road, partly through a loose-jointed pipe which followed the line of the ditch down one side of the road and partly direct from the road surface. The pond was and always had been a drinking place for cattle, which were also at times watered from the farm well near the roadside. The fields below the farm were subject to flooding, and tar had been found there, and a stream which crossed the road at the lower end of these fields was alleged also to have been polluted by tar.

Enderby Lane had been a water-bound road until June 26, 1929, when it was sprayed with tar supplied by the Midland Tar Distillers, Ltd., to the Blaby Rural District Council, which tar was stated later to have contained 4% of phenols or crude tar-acids. The plaintiff kept 80 to 90 head of cattle, and no trouble arose to them from the tar-spraying until January, 1930. By that time, plaintiff's counsel stated, the tarred surface had become badly worn and pot-holed. There was heavy rain in the latter part of 1929. On Jan. 2, 1930, a pedigree bull died. On the following day one cow died, and on Jan. 7 another cow, followed by another on the 11th, another on the 14th, and another on the 16th. There were no further casualties until March 6, when a cow was attacked after drinking the well-water, and died under treatment some 10 or 11 days later. A few days later two other cows were similarly attacked, and though under veterinary treatment ultimately became "screws" and had to be slaughtered.

The road was re-dressed with tar from the same suppliers (who stated later that this delivery contained only 2·8% of phenols) on Sept. 15 to 18, 1930, on which days rain fell at times, and on the 19th a cow fell sick and was slaughtered at the instance of the veterinary surgeon, who wished to make an immediate post-mortem, and to send the contents of the bladder for analysis. No further cases of damage to plaintiff's cattle occurred.

The *Plaintiff* stated in evidence that he bought the farm in 1920, but had lived there previously. The cattle until January, 1930, had been in good health, but a Friesian bull, about 12 months old, then died shortly after watering at the roadside pond. Then followed the deaths of cows, mostly in calf, as already stated. The bull was worth fifty guineas, and the cows, with one exception, £35 each. After the death of the third beast, he called in a veterinary surgeon, whose post-mortem revealed nothing, and after the death of the fourth beast samples of water from the drinking place and other material were sent to Dr. Clough, of the Royal Veterinary College, London, for examination. He found no evidence of poisoning. After the death of other cows, samples of water were sent to Mr. S. B. Bratley, an analyst of Oadby, to whom also was sent the contents of the bladder of the cow which was slaughtered shortly after being attacked by sickness in September, 1930. Evidence was given in support of the plaintiff's case by Messrs. Benbow & Thornton, veterinary surgeons of Leicester, Mr. S. B. Bratley, the analyst, some farm hands, and three farmers who had visited the farm in March, 1930, on behalf of the Farmers' Union. The

By Appointment
Ironfounders to
H.M. The King.

CARRON
GAS FIRES

Duplex or Simplex Silent Burner, Air Adjuster, chromium-plated Reflector. All parts accessible from front. Made in the following attractive finishes.

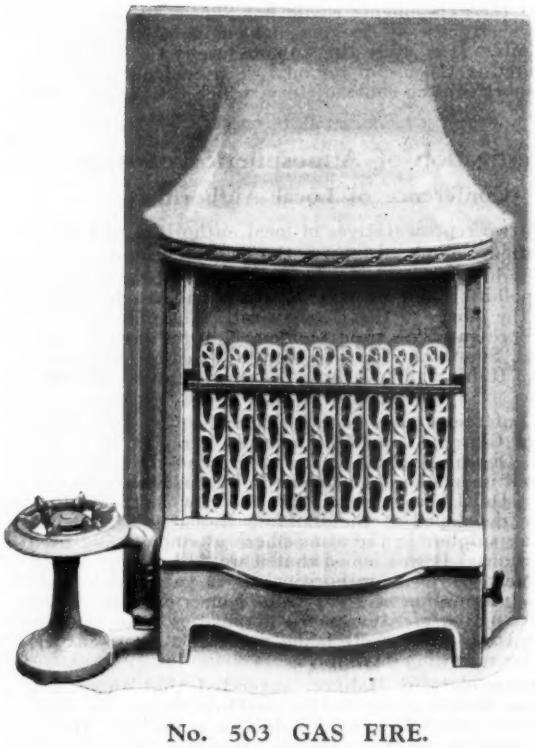
Vitreous Enamelled Black—Ground and Berlin Blacked—Armour Bright—Electro-Bronzed—Enamelled in Standard Colours.

Write for Catalogue No. 6R

CARRON COMPANY
FOUNDED 1759

Works - CARRON, STIRLINGSHIRE

Showrooms: LONDON—15, Upper Thames Street, E.C.4; LIVERPOOL — 22/30, Redcross Street; GLASGOW — 125, Buchanan Street; EDINBURGH — 114, George Street; BRISTOL—62, Prince Street.



No. 503 GAS FIRE.
With Pedestal Boiling Burner.

analyst's reports showed that one sample of water from the roadside well contained about one-tenth of a grain of phenol per pint, and the contents of the bladder of the slaughtered cow yielded 0·08% of phenols. In cross-examination, one of the veterinary surgeons called by the plaintiff admitted that this proportion of phenol might be expected in the normal urine of a cow.

The Defence.

Mr. FENWICK, in opening the defence, said that millions of gallons of tar had been put on the roads in this country, and so far as was known there was only one instance, about 25 years ago, in which a cow was found to have been poisoned by tar from the road. In that case, the tar ran into the field in which the animal was grazing. It would be most damaging to the tar industry and indirectly to the Gas Industry if the case for the plaintiff were proved. He (counsel) did not rely on points of law for an award in the defendant's favour, because a victory on such grounds alone would be extremely damaging to road-tar. He therefore asked the Arbitrator to decide in favour of the defendants on points of fact.

The witnesses called by the County Council included the Surveyor and Road Foreman responsible for the work of tar-spraying, an Assistant to the County Surveyor who had prepared plans, &c., Mr. T. E. Fellows, Sales Manager of the Midland Tar Distillers, Ltd., Dr. G. D. Lander, formerly Professor of Chemistry at the Royal Veterinary College, Professor Wooldridge of the Royal Veterinary College, and Mr. W. J. A. Butterfield, F.I.C. The last named spoke as to the phenolic content of washings from tarred roads, while Professor Wooldridge proved that cattle which had been continuously watered for three months with water containing 50% more phenol than the maximum found by Mr. Bratley in the farm water had remained in fully as good health as cattle which were given clean water. Dr. Lander and Professor Wooldridge also testified that the results of the post mortems conducted by the veterinary surgeons called in by the plaintiff were not consistent with tar or phenol poisoning.

The case occupied the Court for four days, and the Arbitrator gave his award in writing on Wednesday, Dec. 5. His findings were:

(1) There was no negligence by the defendants (the Leicestershire County Council and the Blaby Rural District Council) or either of them in and about the said tar-spraying. The work was performed with due skill and care. The tar used showed on analysis a proportion of tar acids less in every case than that prescribed by the Specifications of the Ministry of Transport, and in the case of the September, 1930, tar less than half the proportion of the said acids.

(2) The plaintiff's cattle did not die as the result of tar poisoning, or of any washings from the road.

(3) The defendants did not employ any tar which contained poisonous or deleterious ingredients injurious to cattle.

In accordance with the Order, the Arbitrator directed that judgment be entered for the defendants with costs to be taxed and paid by the plaintiff.

Beit Fellowships for Scientific Research.

Applications for the Beit Fellowships for Scientific Research—which were founded and endowed by Mr. Otto Beit (London) in 1913 "to promote the advancement of Science by means of Research"—must be received on or before April 11, 1935. Copies of the Conditions of the Award and the Form of Application may be obtained from the Secretary of the Institution of Gas Engineers, 28, Grosvenor Gardens, London, S.W. 1.

Not more than three Fellowships, each of the annual value of £240 and tenable for a period of two years, will be awarded on or about July 12, 1935, to candidates, under the age of 25 years, who "are of marked promise and are likely to become researchers above the average."

The Beit Scientific Research Fellows work for the whole of their time under the supervision of a Professor of a Department of the Imperial College of Science and Technology, and must not, without permission, take or hold any appointment whether paid or unpaid. Applicants have to state the general character of the research which they propose to carry on, but the Trustees specify the work of research which they are authorized to carry on.

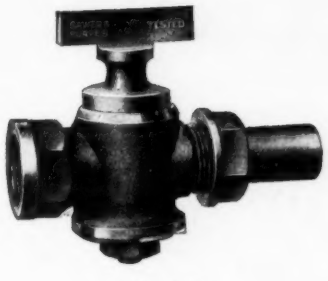
Every Fellow shall be a person, man or woman, of European descent by both parents, but otherwise of any nationality whatsoever, who at the date of election shall have taken a degree in any Faculty in any University in the British Empire approved by the Trustees, or have passed the examinations which would have entitled him or her to take any such degree, or is in possession of any Diploma or Associateship of any College approved by the Trustees.

SAWER & PURVES
(BRANCH OF METERS LTD.)

OUR MAIN TAPS
ARE UNSURPASSED
FOR QUALITY.

PRICES RIGHT.

May We Quote You?



No. 119.

Makers of

ORDINARY . . . .
PREPAYMENT . . .
TWO-COIN . . . .
HIGH CAPACITY .

METERS

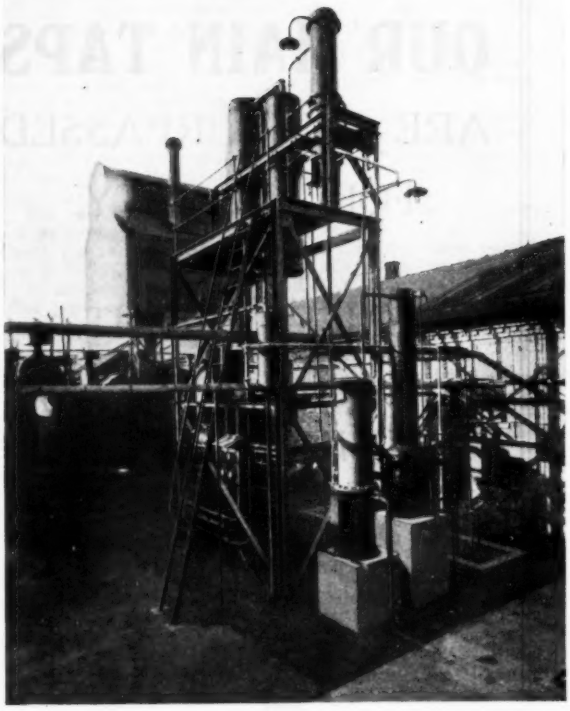
DERBY ROAD
WATFORD
PHONE: 2645
GRAMS: 2645 SAWER, WATFORD

RADFORD ROAD
NOTTINGHAM
PHONE: 75202
GRAMS: SAWER, NOTTINGHAM

MILES PLATTING
MANCHESTER, 10
PHONE: COLLYHURST 2289
GRAMS: SAWER MANCHESTER

BENZOLE PLANT

FOR LARGE & SMALL WORKS.



Thorncliffe type Benzole Recovery Plant at the Hampton Court Gas Co., Hampton Wick, Middlesex.

This plant will produce:—

1·85 galls. of benzole per ton of coal distilling 93°/₀ at 120° C.

or

2·25 galls. of benzole per ton of coal distilling 85°/₀ at 120° C.

Any required variation in product can be obtained by thumb screw adjustment.

(1) Any quality of benzole guaranteed from 70°/₀-95°/₀ at 120°C.

(2) Lowest possible water, steam and wash-oil consumption.

(3) Small ground space required.

(4) Existing gas washers can be adapted.

(5) Plants in operation can be inspected.

(6) Low capital cost.

NEWTON CHAMBERS & CO LTD
THORNCLIFFE
Nr SHEFFIELD

Dickson

Gas Markets and Manufactures

Stock Market Report.

[For Stock and Share List, see later page.]

As is usual after a long period of upward price movements, a marking time period arrives giving investors an opportunity to take fresh stock of the situation. This coincides as a rule with a spell of profit-taking, but the tone has been so strong that until now any movement in this direction has had little, if any, effect on values. Last week, however, there was a definite reduction in the volume of business in most markets, and prices were inclined to weaken. There were a few bright spots, the feature being a revival of activity in gold-mining shares brought about by the optimism regarding the forthcoming dividends.

The demand for Gas stocks and shares showed no signs of falling off; in fact, the number of recorded transactions was particularly heavy, especially in Imperial Continental stock. Prices also appreciated in several cases, and the only reflection of the general position was in the marking down of Gas Light units by 3d. to 28s. 6d., and South Metropolitan ordinary by 3 to 152½. Among the increases, the features were a rise of 4 in British ordinary to 176½, which, by the way, is 19 points higher than a year ago, an increase of 6d. in Newcastle units to 26s. 9d. at Newcastle, and a gain of 3 in Imperial Continental to 215.

Subject to the approval of the Board of Trade, the Sheffield Gas Company has entered into an agreement to acquire the Matlock and District Gas Company and to extend the area of supply in Derbyshire. The Matlock shareholders will receive ordinary stock of the Sheffield Company, which it is proposed to create for the purpose, in place of their present holdings.

Current Sales of Gas Products.

The London Market for Tar Products.

LONDON, *Dec.* 10.

There is but little change to report in the prices of tar products, which are as follows:

Pitch, 48s. to 49s. per ton f.o.b.

Creosote is firm at 4½d.

Refined tar, 4d. to 4¼d. per gallon in bulk at makers' works.

Pure toluole, about 2s. 2d.

Pure benzole, 1s. 9d. to 1s. 10d.; 95/160 solvent naphtha, 1s. 7d.; and 90/160 pyridine, 6s. 3d. to 6s. 6d.—all per gallon naked at makers' works.

Tar Products in the Provinces.

Dec. 10.

The average prices of gas-works products during the week were: Gas-works tar, 21s. 6d. to 26s. 6d.; Pitch—East Coast, 47s. 6d. to 50s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 47s. 6d. to 50s.* Toluole, naked, North, 1s. 6d. to 1s. 8d. Coal-tar crude naphtha, in bulk, North, 6½d. to 6¾d. Solvent naphtha, naked, North, 1s. 4d. to 1s. 4½d. Heavy naphtha, North, 9¾d. to 10¼d. Creosote, *ex* works, in bulk, North, liquid and salty, 3½d. to 3⅝d.; low gravity, 3½d. to 3⅝d.; Scotland, 3⅝d. to 3⅝d. Heavy oils in bulk, North, 3⅝d. to 4½d. Carbolic acid, 60's, 1s. 8d. to 1s. 9d. Naphthalene, £10 to £11. Salts, 55s. to 75s., bags included. Anthracene, "A" quality, 2½d. to 3d. per minimum 40%, purely nominal; "B" quality, unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Dec.* 8.

With the exception of creosote oil, the market has been quiet during the week, although quotations show no appreciable alteration.

Crude gas-works tar.—Actual value is 30s. to 32s. per ton *ex* works in bulk.

Pitch.—Business continues difficult, but makers' prices are unchanged at 43s. to 44s. per ton f.o.b. Glasgow for export and 42s. 6d. per ton *ex* works in bulk for home trade.

Refined tar is unchanged at 3d. to 3⅛d. per gallon f.o.r. naked.

Creosote oil.—Railway business has been placed during the week. B.E.S.A. Specification, 3⅞d. to 4d. per gallon; low gravity, 4¼d. to 4½d. per gallon; and neutral oil, 4d. to 4¼d. per gallon; all f.o.r. in bulk.

Cresylic acid.—Market is rather dull. Pale, 97/99%, is 1s. 2½d. to 1s. 3½d. per gallon; dark, 97/99%, 1s. 0½d. to 1s. 1½d. per gallon; and pale, 99/100%, 1s. 4d. to 1s. 5d. per gallon; all *ex* works.

Crude naphtha.—Available supplies continue to command 4½d. to 5d. per gallon f.o.r., according to quality and district.

Solvent naphtha.—90/160 grade is 1s. 3d. to 1s. 4d. per gallon, and 90/190 grade is round 8d. to 9d. per gallon, according to quantity.

Motor benzole is easier at 1s. 4d. per gallon.

Pyridines.—90/160 grade is 6s. to 6s. 6d. per gallon, and 90/140 grade 6s. 6d. to 7s. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s. d.		s. d.	
Crude benzole	0 9	to	0 9½	per gallon at works
Motor ,,	1 3½	,,	1 4	,, ,, ,,
90% ,,	1 4	,,	1 4½	,, ,, ,,
Pure ,,	1 7½	,,	1 8	,, ,, ,,

Contracts Advertised To-Day.

Carbonizing Plant.

Milford Haven Urban District Council. [p. 846.]

Lamp Columns.

Carlisle Gas Department. [p. 846.]

Lanterns.

Carlisle Gas Department. [p. 846.]

Trade Notes.

Wearmouth Gas Coal.

The France Fenwick Tyne and Wear Company, Ltd., of Mercantile Chambers, Quayside, Newcastle-on-Tyne, have issued an attractive brochure descriptive of Wearmouth Gas Coal, for which well-known brand of "Wear Specials" they are selling and shipping agents. An account of the colliery plant is given, as well as averages of a large number of analyses.

Improved Method of Painting.

We have received from the Bromax Pneumatic Paint Brush Company, Ltd., Rex House, 38, King William Street, London, E.C. 4, particulars of their pneumatic paint brush, which is at present being exhibited at the Novelty Exhibition at the Building Centre, Bond Street. The paint is fed by tubes from the pressure container into the bristles of the brush, the rate of flow being controlled by means of a small button on the brush.

New Capital Issues.

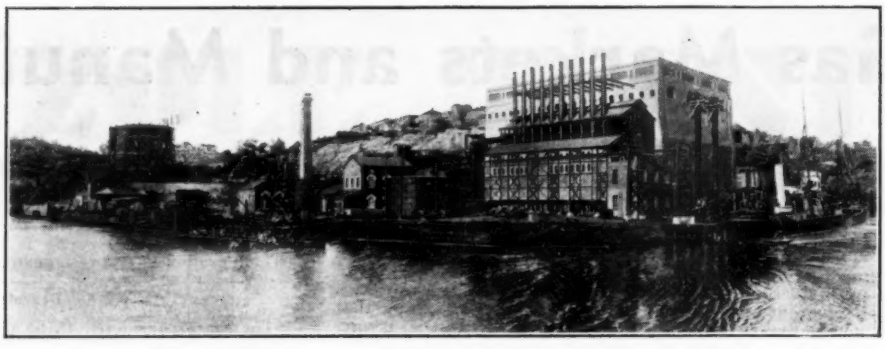
The Barnet District Gas and Water Company opened tenders on Dec. 10 for the £25,000 4½% preference stock. The total applications amounted to £185,000 at prices ranging from £122 6s. per £100 down to the minimum of £114 per £100. The whole of the stock was allotted at £122 6s.

Toronto's Good Year.

The eighty-sixth annual report of the Directors of the Consumers' Gas Company of Toronto for the year ended Sept. 30, 1934, shows that despite unfavourable general business conditions, the figures of the balance-sheet and income account are distinctly gratifying and serve to indicate the success which the Company has had in withstanding the most severe financial strain it has encountered during the eighty-six years of its history. Gross income for the year amounted to $7,250,627.61 and expenditure to $5,405,887.14, leaving net earnings of $1,844,740.47. $508,294.02 was transferred from reserve fund. Interest, dividends, and plant and buildings renewals fund totalled $2,353,034.49. The output of gas for the year was slightly in excess of that for last year. During the first four months the gas output was somewhat less than in the corresponding period of 1933, but the output for the last eight months showed an encouraging upward trend and exceeded that of the same period of last year sufficiently to overcome the decreases of the earlier months. On May 7 a total volume of 21,831,000 c.ft. of gas was distributed, which constitutes an all-time record output for a single day.

The Coatbridge Gas Company have given notice that as from March 1, 1935, they intend to supply gas of a calorific value of 500 B.Th.U. per c.ft. gross, instead of 475 B.Th.U. as at present.

The installation of Glover-West vertical retorts at the works of the North Shore Gas Company of Sydney, N.S.W.



Another repeat order for West's carbonizing plant

From the North Shore Gas Company of Sydney, New South Wales, we have received a contract for an installation of Westvertical carbonizing chambers with an estimated daily capacity of 3 million cubic feet. The new unit will augment the present Glover-West vertical retort plant at the North Shore works, and both will be served by an extensive new coal and coke handling plant.

WEST'S CARBONIZING & FUEL-HANDLING SYSTEMS

GLOVER-WEST VERTICAL RETORTS . . . . . WESTVERTICAL CARBONIZING CHAMBERS

THE WEST LIP-BUCKET CONVEYOR WITH AUTOMATIC FORCED LUBRICATION . . . ALL TYPES OF CONVEYORS, ELEVATORS AND SKIP-HOISTS . . . COKE CRADERS . . . BREEZE-BURNING PRODUCER EQUIPMENT . . . ETC., ETC.

WEST'S GAS IMPROVEMENT CO., LTD.

LONDON: REGENT HOUSE, KINGSWAY, W.C. 2
'PHONE: HOLBORN 4108. 'GRAMS: "IMVERTRET, WESTCENT."

MANCHESTER: MILES PLATTING, MANCHESTER, 10
'PHONE: COLLYHURST 2961. 'GRAMS: "STOKER, MANCHESTER"

STOCK AND SHARE LIST.

Official Quotations on the London and Provincial Stock Exchanges.

Issue. £	Share.	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations. Dec. 7.	Rise or Fall on Week.	Transactions. Lowest and Highest Prices During the Week.
1,551,868	Stk.	Sept 10	7	7	Alliance & Dublin Ord. ...	135—145	...	135⅞—136½
374,000	"	June 25	4	4	Do. 4 p.c. Deb. ...	90—100	...	...
567,655	"	Aug. 13	7	7	Barnet Ord. 7 p.c.	168—173	...	...
300,000	1	Oct. 8	1/9‡	1/4‡	Bombay, Ltd.	1⅛—1⅜	...	31/3
178,480	Stk.	Aug. 13	9½	9½	Bournemouth sliding scale	227—237	+2	234—236
550,050	"	"	7	7	Do. 7 p.c. max. ...	170—175	...	...
439,160	"	"	6	6	Do. 6 p.c. Pref ...	150—155	...	...
50,000	"	June 11	3	3	Do. 3 p.c. Deb. ...	87—92	...	...
262,025	"	"	4	4	Do. 4 p.c. Deb. ...	105—110	...	108½
335,000	"	"	5	5	Do. 5 p.c. Deb. ...	125—130	...	...
357,900	"	Aug. 13	7½	7½	Brighton, &c., 6 p.c. Con. ...	175—185	...	182
540,000	"	"	6½	6½	Do. 5 p.c. Con. ...	158—163	...	...
195,500	"	"	6	6	Do. 6 p.c. B. Pref.	145—150	...	...
1,487,500	"	July 9	5	5	Bristol 5 p.c. max.	120—122[a]	...	...
120,420	"	June 11	4	4	Do. 1st 4 p.c. Deb. ...	103—106[a]	...	...
217,870	"	"	4	4	Do. 2nd 4 p.c. Deb. ...	103—106[a]	...	...
338,790	"	"	5	5	Do. 5 p.c. Deb.	123—125[a]	...	...
855,000	"	Sept. 24	8	7	British Ord.	174—179	+4	176—177
100,000	"	June 11	7	7	Do. 7 p.c. Pref.	158—163	...	162½
120,000	"	"	4	4	Do. 4 p.c. Red. Deb. ..	98—103	...	...
450,000	"	"	5	5	Do. 5 p.c. Red. Deb. ...	110—115	...	...
100,000	10	22 May '33	6	4	Cape Town, Ltd.	2—4	...	...
100,000	10	Nov. 6	4½	4½	Do. 4½ p.c. Pref. ...	4—6	...	...
150,000	Stk.	July 23	4½	4½	Do. 4½ p.c. Deb. ...	90—95	...	90½
626,860	"	July 23	6	6	Cardiff Con. Ord.	135—140	...	...
287,860	"	June 11	5	5	Do. 5 p.c. Red. Deb.	107—112	...	...
157,150	"	July 23	6½	5	Chester 5 p.c. Ord.	118—118[b]	...	...
98,936	1	Sept. 24	2/-	2/-	Colombo, Ltd. Ord.	1⅞—1⅞	...	...
24,500	1	"	1/4⅜	1/4⅜	Do. 7 p.c. Pref. ...	19/6—21/6	...	...
609,204	1	Sept. 24	/11'48	/11'48	Colonial Gas Assn. Ltd. Ord.	19/6—21/6	...	...
296,058	1	"	1/3'30	1/3'30	Do. 8 p.c. Pref.	24/6—26/6	...	...
1,775,005	Stk.	July 23	6½	5	Commercial Ord.	122—127	...	125—127
475,000	"	Dec. 3	3	3	Do. 3 p.c. Deb. ...	87—91*	−1	...
286,344	"	Aug. 13	5	5	Do. 5 p.c. Deb. ...	122—127	...	...
807,560	"	Aug. 13	7	7	Croydon sliding scale ...	165—170	...	168—170
569,890	"	"	5	5	Do. max. div.	112—117	...	...
620,385	"	June 25	5	5	Do. 5 p.c. Deb.... ...	123—128	...	...
542,270	"	Aug. 13	10	7	Derby Con.	195—205[e]	...	...
55,000	"	June 25	4	4	Do. 4 p.c. Deb.	100—105[e]	...	...
209,000	"	Aug. 13	5	5	East Hull Ord. 5 p.c. ...	113—118	...	...
181,625	"	Aug. 13	6	6	East Surrey Ord. 5 p.c. ...	137—142	...	...
175,609	"	June 11	5	5	Do. 5 p.c. Deb. ...	120—125	...	...
1,002,180	"	Sept 10	†7	†5	European, Ltd.	122—127	...	121½—123½
19,342,763	"	Aug 13	5⅝	5⅝	Gas Light & Coke 4 p.c. Ord.	28'—29'-[f]	−·/3	27/10½—28/9
2,600,000	"	"	3½	3½	Do. 3½ p.c. max.	93—97	−½	93—96½
4,477,106	"	"	4	4	Do. 4 p.c. Con. Pref. ...	108—111	...	109—110
6,102,497	"	Dec. 3	3	3	Do. 3 p.c. Con. Deb. ...	89—92*	...	89—90½
3,642,770	"	"	5	5	Do. 5 p.c. Red. Deb. ...	118—121*	...	118—119
3,500,000	"	"	4½	4½	Do. 4½ p.c. Red. Deb. ...	116—119*	−1	117½—118½
270,466	"	Aug. 13	6	6	Harrogate New Cons. ...	140—145	...	144—144½
140,000	1	Sept 24	1/7½	1/7½	Hongkong & China, Ltd. ...	1⅛—1⅜	...	...
213,200	Stk.	Aug. 13	6	6	Hornsey Con. 3½ p.c. ...	137—142	...	...
5,600,000	"	Oct. 22	14	10	Imperial Continental Cap.	210—230	+3	210—221
228,180	"	July 23	3½	3½	Do. 3½ p.c. Red. Deb.	92—97	...	...
285,242	"	Aug. 13	8½	8½	Lea Bridge 5 p.c. Ord. ...	190—200	...	197
2,167,410	"	Aug. 13	6	6	Liverpool 5 p.c. Ord. ...	142½—144½[b]	+2	...
245,500	"	June 11	5	5	Do 5 p.c. Red. Pref. ...	105—110[b]	...	...
306,083	"	July 16	4	4	Do. 4 p.c. Deb. ...	103—106[b]	+1½	...
11,751	"	Aug. 27	10	8	Maidstone 5 p.c. Cap. ..	188—198	...	...
63,480	"	June 25	3	3	Do. 3 p.c. Deb. ...	84—89	...	...
75,000	"	Dec. 3	†10	†10	Malta & Mediterranean ...	195—205*	−5	...
392,000	—	Oct 1	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	100—103	...	...
231,978	Stk.	Aug. 13	5	5	M. S. Utility "C." Cons. ...	115—120	+2	...
818,657	"	"	4	4	Do. 4 p.c. Cons. Pref.	101—106	+1	101½
860,075	"	June 11	4	4	Do. 4 p.c. Deb. ...	99—107	...	...
148,955	"	"	5	†5	Do. 5 p.c. Deb. ...	122—127	...	...
125,000	—	July 2	...	11/8	Do 3½ p.c. Rd. Rg. Bds.	97—100	...	...
675,000	"	May 28	†6	†13	Montevideo, Ltd.	55—65	−2½	61½
2,061,815	"	Aug. 13	5½	5	Newcastle & Gateshead Con.	26/3—27/3[d/f]	+·/6	...
682,856	"	"	4	4	Do. 4 p.c. Pref. ...	105—107[d]	...	...
776,706	"	June 11	3½	3½	Do. 3½ p.c. Deb. ...	100—102	...	...
277,285	"	Oct. 8	5	5	Do. 5 p.c. Deb. '43 ...	105—107[d]	...	...
274,000	"	Aug. 13	5	5	Newport (Mon.) 5 p.c. max.	110—112[a]	...	...
204,940	"	Aug. 13	7½	7½	North Middlesex 6 p.c. Con.	170 175	...	175
390,160	"	Aug. 13	5	5	Northampton 5 p.c. max. ...	107—112	...	...
300,000	"	Nov. 5	†7	†9	Oriental, Ltd.	166—171	...	...
416,617	"	June 11	8	8	Plym'th & Stonehouse 5 p.c.	183 -188	...	...
504,416	"	Aug. 13	8	8	Portsm'th Con. Stk. 4 p.c. Std.	182—187	...	18'—186½
241,446	"	"	5	5	Do. 5 p.c. max. ...	110 -115	...	111½
114,000	"	July 23	5	5	Preston 5 p.c. Pref. ...	101—106	...	...
1,736,968	Stk.	Aug. 27	6	6	Sheffield Cons.	143—147[e]	+2	...
95,000	"	July 9	4	4	Do. 4 p.c. Deb. ...	100—104[e]	...	...
133,201	"	Aug. 13	8	8½	Shrewsbury 5 p.c. Ord. ...	154—159	...	158½
90,000	10	May 28	‡4	‡3	South African	3—4	...	...
927,177	1	Sep. 10	1/2⅞	1/2⅞	South East'n Gas Cn. Ld Ord.	30/6—32/6	...	31/1½—32/3
736,061	1	"	-/10⅞	-/10⅞	Do. 4½ p.c. Red. Cum. Pref.	22/6—23/6	...	...
450,000	Stk.	Aug. 13	7¼	4	Do. 4 p.c. Red. Deb. ...	102—105	...	...
6,709,895	"	Aug. 13	7	5	South Met. Ord.	150—155	−3	150—154
1,135,812	"	"	6	6	Do. 6 p.c. Irred. Pf.	148—153	...	151—152½
850,000	"	"	4	4	Do. 4 p.c. Irred. Pf.	107—110	...	108½
1,895,445	"	June 25	3	3	Do. 3 p.c. Deb. ...	90—93	...	90—92
1 000,000	"	July 9	5	5	Do. 5 p.c. Red. Deb.	117—121	...	119½
209,820	"	Aug. 13	8½	8½	South Shields Con.	185—187[d]	...	...
1,548,795	"	July 9	6	6	South Suburban Ord. 5 p.c.	144—149	...	147
512,825	"	"	5	5	Do. 5 p.c. Pref.	124—129	...	125½
300,000	"	"	4	4	Do. 4 p.c. Pref.	102—107	...	...
868,837	"	June 11	5	5	Do. 5 p.c. Deb.	125—130	...	...
100,000	"	"	4	4	Do. 4 p.c. Deb.	108—113	...	...
647,740	"	Aug. 13	5	5	Southampt'n Ord. 5 p.c. max.	118—123	...	121½—121½
121,275	"	June 11	4	4	Do. 4 p.c. Deb.	102—107	...	...
350,000	"	Aug. 13	5½	5½	Swansea 5½ p.c. Red. Pref.	113—118	...	...
200,000	"	June 11	6½	6½	Do. 6½ p.c. Red. Deb.	102—107	...	105—106
1,076,490	"	Aug. 13	6½	6½	Tottenham and District Ord.	163—168	...	163—164
409,835	"	"	5½	5½	Do. 5½ p.c. Pref. ...	130—135	...	...
62,235	"	"	5	5	Do. 5 p.c. Pref. ...	122—127	...	124
199,005	"	Dec. 3	4	4	Do. 4 p.c. Deb. ...	101—106*	−1	...
349,110	"	Aug. 13	7	7	Uxbridge, &c., 5 p.c. ...	165—170	...	...
88,330	"	"	5	5	Do. 5 p.c. Pref. ...	124—129	...	...
1,326,700	"	Aug. 13	7	7	Wandsworth Consolidated	165—170	...	168—170
1,371,373	"	"	5	5	Do. 5 p.c. Pref.	124—129	...	127—128½
1,317,964	"	June 11	5	5	Do. 5 p.c. Deb.	125—130	...	...
208,307	"	"	...	26/8	Do. 4 p.c. Deb.	107—110	...	...
158,400	"	Aug. 13	6g	5	Winchester W. & G. 5 p.c. Con.	120—125	...	...

Quotations at:—*a.*—Bristol. *b.*—Liverpool. *c.*—Nottingham. *d.*—Newcastle. *e.*—Sheffield. *f.*—The quotation is per £1 of stock. *g.*—Paid £8, including 10s. on account of back dividends. * Ex. div. † Paid free of income-tax. ‡ For year.

COMPANY NOTICES.

THE BARNET DISTRICT GAS AND WATER COMPANY.

NOTICE is Hereby Given that the TRANSFER BOOKS of this Company relating to DEBENTURE STOCK WILL BE CLOSED on the 24th December, 1934, and RE-OPENED on the 1st January, 1935.

By order of the Board,
E. D. DAVEY,
Secretary.

Offices:
139, Cannon Street,
London, E.C. 4,
Dec. 12, 1934.

HORNSEY GAS COMPANY.

NOTICE is Hereby Given that the TRANSFER BOOKS of this Company, relating to DEBENTURE STOCK only, WILL BE CLOSED from the 18th to the 31st December, 1934, both days inclusive.

By order of the Board,
K. LESLIE MORTIMORE,
General Manager and Secretary.

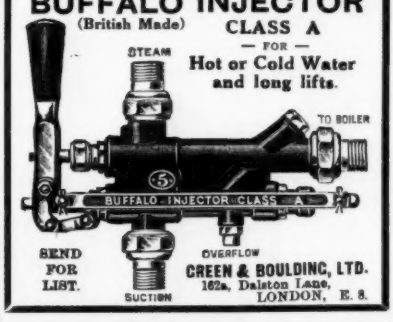
Gas-Works,
Hornsey, N. 8,
Dec. 10, 1934.

OXIDE

CONSULT

THE BRITISH GAS PURIFYING MATERIALS CO., LTD.,
99, LONDON ROAD, LEICESTER.
Telegrams: "BRIPURIMAT, LEICESTER." Telephone: LEICESTER 59086.

BUFFALO INJECTOR
(British Made) CLASS A
— FOR —
Hot or Cold Water and long lifts.

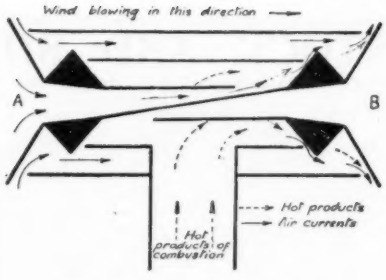


SEND FOR LIST.
CREEN & BOULDING, LTD.
162a, Dalston Lane, LONDON, E. 8.

CAST IRON PIPES
FOR
GAS, WATER, & STEAM
1¼in. to 12in. BORE.

THOS. ALLAN & SONS, LTD.,
Bonlea Foundry,
THORNABY-ON-TEES.
Telegrams: "BONLEA, THORNABY-ON-TEES."
Telephone No.: STOCKTON 66121 (Two lines).

The 'Sergeant' shows some Specialities



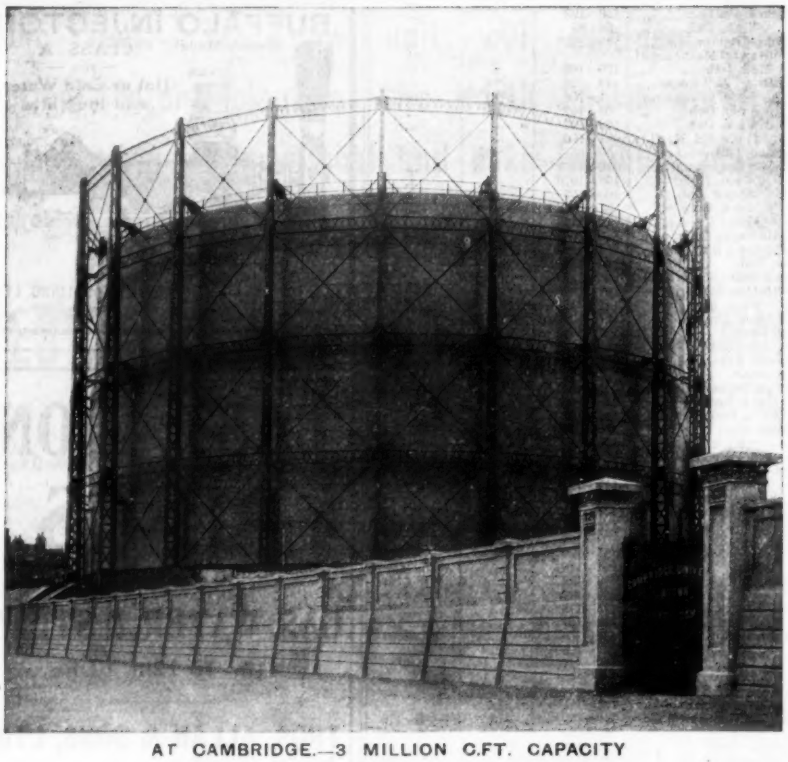
THE A.E.M. EXTRACTOR COWL

This cowl is the invention of a Distribution Superintendent of many years' practical experience and it has made the installation of geysers, cookers, and fires satisfactory under conditions previously considered impracticable. The illustration shows the principle upon which this cowl is constructed. It is made in sheet copper and galvanised iron and is available in various sizes.

ALDER & MACKAY LIMITED

MAKE METERS OF METICULOUS MEASUREMENT.

ALDER & MACKAY LTD., EDINBURGH, LONDON & BRADFORD



AT CAMBRIDGE.—3 MILLION C.FT. CAPACITY

GAS HOLDERS

GUIDE FRAMED
AND
SPIRAL GUIDED
WITH OR WITHOUT
STEEL TANKS
WATERLESS (KLÖNNE) GASHOLDERS
HIGH PRESSURE GASHOLDERS

C. & W. WALKER, LTD. DONNINGTON, NR. WELLINGTON—SHROPS.

LONDON OFFICE: 70, VICTORIA STREET, WESTMINSTER, S.W. 1.